

November 25, 1957 75 cents

AVIATION WEEK

A McGRAW-HILL
PUBLICATION

Douglas Thor



Special Report
On Rocketdyne

•
Orpheus May Fill
Wide Market Role

*he's on our
payroll...*



—but he's working for you

This man is hard to please. Nothing sheet of optimism accuracy and consistency to specifications satisfies him. We like it that way, and are glad we have many more people in the Inspection Departments here at Foote Bros. just like him.

Motivation and exhaustive inspection is an important part of our production processes. It gives him, because quantity production of precision gearing and actuating mechanisms for the aviation industry is our business.

It is men like these who work for you, and, in a very real sense, are the guardians of the Foote Bros. reputation for producing the finest components and assemblies of their type.

Another reason to come to Foote Bros. first, when it comes to aircraft power transmission, actuation, or gearing.

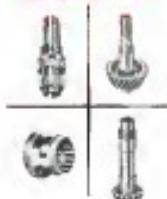
This precision stands for the best industrial gearing made.



Bolts Power Transmission Through Bolts Gear
FOOTE BROS. GEAR AND MACHINE CORPORATION
4152 South Western Avenue, El Segundo 5-1110

Dull-Rated

FOOTE BROS.



Propjet with shortfield capabilities

—brakes by Goodyear



Tin-Metallized Brake step T-27 on 3,000-Foot Aerotrips

In the F-27, being produced by Fairchild Engine and Airplane Corporation, short-field landing range operation at first got a propjet transon that combines much needed speed with shortfield capabilities.

A good lot of the credit for enabling such a performance as the F-27 to use runways as short as 3,000 feet goes to its Tin-Metallized disc brakes.

Developed by Goodyear Aviation Products — which also supplied the long roll life, lightweight wheels for the aircraft — this new braking principle combines disc brake efficiency with a new reliable lining material.

Requiring 200 fewer parts than comparable brakes, giving up to 50% increase in heat absorption per pound of brake weight, and needing no adjustment of any kind through the

full life of the brake lining—the pneumatically operated Tin-Metallized Brakes by Goodyear is the single, dependable answer to aircraft design problems where speed, space and weight are critical factors.

WRITE-RIGHT NOW—for information on the brakes that stop the hot ones—the big ones, the shortfield aircraft you're going to build! Address: Goodyear, Aviation Products Division, Akron 36, Ohio, or Los Angeles 56, California.



GOODYEAR AVIATION PRODUCTS
Division of Goodyear Tire & Rubber Company



New Durability
New Design Flexibility
with



F-R-P BUFFET INSERTS



Aeronautical engineers confirm that Strength reinforced plastic (F-R-P) Buffet Inserts are offered by Weber provide enormous design performance and cost advantages. Compare the F-R-P inserts with metal "buffers," note that plastic offers:



GREAT STRENGTH
Stronger, lighter, no
rust, even rusting
do not destroy these
resistant inserts.



RESISTANCE TO AGING
moisture and fungus
safe — can "take it"
for years.



ECONOMICAL
No cost studies prove
Weber can economically
cost even a few
cents exactly as you'd
like them. Minimum
maintenance cost too.



SMOOTH CONTOURS
no sharp edges or
corners, made of cast
molded in one piece

AVIATION CALENDAR

Sep. 29—Board of Directors Meeting, Air Transport Ass'n, Statler Hotel, Washington, D.C.

Oct. 25—Sales Agents of Refrigeration in America, Second Session, The Royal Lancaster Hotel, London, England.

Nov. 26—Annual Membership Meeting, Air Transport Ass'n, Statler Hotel, Washington, D.C.

Nov. 28—Mid-Atlantic Meeting, American Panel Writers Group for Scientific Research and Development, Statler Hotel, Washington, D.C.

Sep. 26—Mid-Atlantic Sectional Meeting, Ass'n of American Airlines, Hotel Statler, New York.

Oct. 26—Inaugural Budget Seminar, Hotel Statler, New York.

Dec. 3—Business Pictures in Aviation, First Annual Meeting, Hotel Statler, New York.

Dec. 10—Annual Meeting, Society of American Travel Agents, Hotel Philadelphia, Pa.

Dec. 4—Aerospace Congress on High Temperature Ceramics, American Ceramic Society, Lab Station, Nat'l. Sci. and Material Council, Phila.

Dec. 9-11—(2nd Eastern) Joint Computer Conference and Exhibit, Statler Park Hotel, Washington, D.C.

Dec. 18-19—Traffic Control Symposium, The Women and Method of the Air Force, Modernization Board, sponsored by the U.S. Air Force, Washington, D.C.

Dec. 18—Grumman's Development Seminar, New York, S. E. Springer, Director, Anzio Coliseum, National Center at Long Island City, Philadelphia, Pa.

Jan. 16—National Aerospace Planning, Procurement, Relocation and Dislocation Hotel, Washington, D.C.

Jan. 13-17—1955 Annual Meeting, Society of Automotive Engineers, Statton Coll. Inn and Hotel Statler, Detroit, Mich.

Jan. 14-15—Yardley Institute for Science, (Continued on page 6)

AVIATION WEEK • NOVEMBER 25, 1957

Vol. 47 No. 21

Editorial: What's in store for the future? By Robert L. Johnson, President, Johnson Publishing Co., Inc., Chicago, Ill. (Continued from page 1)

Advertisement: What's new in aircraft interiors? By John C. Johnson, President, Johnson Publishing Co., Inc., Chicago, Ill. (Continued from page 1)

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AVIATION WEEK, November 25, 1957



HEAT'S ON... and ready to scramble!

The Convair F101A scrambles to intercepting altitude at a moment's notice ... thanks to the reliable Hermetac MC-1 Portable Heater which supplies finely controlled quantities of warm air tempered air for pre-flight servicing.

Heart of the MC-1 is the Heat Exchanger unit assembly fabricated by Lavelle to Hermetac Nelson drawings and specifications. Proved under test to exceed 1,000 hours of continuous operation, the Heat Exchanger assures dependable heat at speed take-off when the F101A is on "alert."

To speed production and on-time delivery, the MC-1 Heat Exchanger is fabricated with special tools, custom designed and built by Lavelle. During a five-year period, frequent review of processing and tooling has enabled Lavelle to improve quality without increasing costs considerably despite using labor and material costs

For comparison, requires precision fabrication—quality workmanship—dependable delivery ... at reasonable cost ... contact Lavelle.

How to obtain fast turn-around service in avionics?



LAVELLE AIRCRAFT CORPORATION • NEWTON, BUCKS COUNTY, PA.
Bensenville, Illinois • Philadelphia, Pa. and Tinton, N.J.

for original equipment—or
replacing inserts in existing buffets...

write for our F-R-P Buffet Insert brochure.

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a subsidiary of Weber Aircraft and Partner, Inc., Inc., Inc.
9900 OAKLAND STREET, BURBANK, CALIFORNIA



at supersonic speeds or stratospheric altitudes

It's Firewheel FOR OXYGEN

* American fighter jet-walkers intercept new in-service — the supersonic Convair F-106A (the Delta Dagger) is one of the newest weapons in the Air Force's inventory. It can fly at wing-tip-to-wing-tip at supersonic speeds and at altitudes above 60,000 feet.

An important part for the pilot is Firewheel's new integrated oxygen system, IP-178001 — designed for the activity pilot on altitude pressure air flights, as well as on low altitude missions. Firewheel is "laying out" with America's newest aircraft development, sharing in all these speed and altitude record flights of both Air Force and Navy aircraft.

Dependable oxygen breathing equipment is Firewheel's forte: regulators, cylinders, oxygen systems for all high altitude pressure air flights.

Approved per MIL-C-2517B

*Engines are proved at Press of man.
Adventurous Pilots are our clients.*

Aeronautical Division
THE FIREWHEEL COMPANY, INC.
6280 Broadway, Buffalo 10, N.Y.

AIRCRAFT REGULATING CONTROLS • OXYGEN BREATHING EQUIPMENT

AVIATION CALENDAR

(Continued from page 5)

- June 19—Postponed to September 26th
7th Annual Boston Convention Valley
and Lincoln County, Southern West
Berkshire, England
- June 20—Wings Meeting Personnel
Written 1960: Schenck, U.S. Cavalry
Aviation Institute, California Institute of
Technology, Pasadena Calif. For details
see Av. G-5 Basic Aircraft '60
and Co. Yer New Calif.
- June 21—Hillman 7—Vanguard luncheon, Inc. Cons.
of Engineers and Surveyors, Price, U.S.
of Architects, California, Los Angeles.
- June 22-24—International Air Show, St. Louis
Motorcycle Club, Missouri, Mo.
- June 23-24—Annual Annual Meeting, Assoc.
of American Surveyor, Miami Beach,
Florida, Engineering Societies Bldg., 26
W. 20th St., N.Y.C.
- June 24-25—National Society of Engineers
Induction, 1951 College Infirmary
Cincinnati, University of Michigan, Ann
Arbor, Mich.
- June 25—Midwest Annual Instrument
Show, Chicago, presented by Northern
California Meter Association and Fox Avi
gation Higher School College, at Los Angeles
Aviation Higher School College, Washington Coll
Bldg., 33rd-Inch Drive, Sacramento.
- Flight Control Panel Integration, Bell
Aerospace, Clinton, Ohio. For details
see M-1-31, Report R-651, Dept.
of Defense.
- July 4—Thompson Conference, Society of
Automotive Engineers, Beach Hotel,
Chicago, Ill.
- July 16-18—In-Flight Safety Fair, at
Tangier, Md., 40th W. Street and
Oleander Street, Department, G.F. En
gineers Club, 131 Spruce St., Pittsburgh,
Pa.
- July 18-19—Second National Conference
on Aviation Medicine, Armed Services
Medical Research, D.C.
- July 18-20—Annual Conference,
American Society of Steel America, Stat
ute of Mechanics Engineers, Statute
Hotel, Hotel Del Norte, Tex.
- July 17-21—1954 Nuclear Congress and
Exposition, 47th St. and Madison Avenue,
Central Park, N.Y.C.
- July 18-19—Fuel Efficiency and Safety
Symposium on Gasoline Models Thomas
Ferguson, hosted to those with Soviet
aviation, South Oldsmobile Laboratories,
West Olds, White Plains, N.Y. To
date over 1000 visitors from 200 of
Non-Weapon & Strategic Bases, U.S.
Naval Training Device Center, Port
Washington, L.I., N.Y.
- Aug. 24-29—Fourth International Inter
munic Show, Carlton Hall, Westminster,
London, England.
- Sept. 3-10—1st IFC RMS, Bureau
Welding U. Toronto, Canada Con
C. B. Stearns Chairman, 147
South Dore, Toronto 1.
- Sept. 8-10—Safe Landing Seminar
Thomson Tire-Mfg. Company, Inc., 100
West Institute of Polytechnic Institute
of Brooklyn, Brooklyn, New York, Bldg.
25 M-75, N.Y.C.
- Sept. 17-18—Institute of Pharmaceutical En
gineers Annual, Sheraton Hotel and
Tower, New York Hotel, New York.



More **THOMPSON** retreads
are used world-wide on Viscounts
than all other treads

In over-ground use as Viscount operations expand.

Thompson Extra-Landings Retreads with the
patented slotted design provide the strongest
elements of superior balance, long wear and de
sign safety—the direct result of Thompson's
advanced development and manufacturing
expertise. Other tire-prop and jet-airliners
will use the revolutionary new Thompson
Jet-Tred with exclusive safety features developed
especially for high speed take-offs and landings.



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Fires of Tire Corporation

International Airport
Airport, 48, Newark

100 Bay Street
Toronto, Ontario, Canada

Can you use . . .

switches triggered by speed



AC engineers have developed speed-sensing switches so sensitive that they operate . . . and continue to operate . . . within limits of .01 . . . This is the most sensitive and switch yet produced . . . and the most accurate method of discriminating up to four critical turbine engine fractions with pre-selected RPM. Current applications bear out this accuracy and sensitivity over switching ranges from 500 to 6000 RPM. Newly developed models are offering a dramatic increase in range. The AC Speed Sensing Control (lightweight, weighing less than four pounds) is a bidirectional logic engine with 11 solid state switches and operates without external power source. It has three modes intended for gas turbine aircraft. For more information about our line of speed-sensing switches for aircraft switching operations, give AC's Milwaukee group a call. If you are an electrical or mechanical engineer and feel you might like to work with AC in Milwaukee, write Mr. Fred Sanders, Supervisor of Technical Employment, at one of:



THE ELECTRONICS DIVISION OF GENERAL MOTORS, MILWAUKEE 1, WISCONSIN

Airframe Fuel Security • Building Monitoring Systems • Emergency Pest Control • Gun-Boat-Target Mights • Gymnastic-Mechanisms • Gyroscopic Inertial Guidance Systems • Manifold Air Pressure Regulators • Speed Sensitive Switches • Speed Sensors • Three-Way Solenoid Valves • Thermometers



At the heart of the switch is a new device multiplying by ASCOP. It takes 27 channels @ 10 KHz, 8 pulses, 17 channels @ 8 KHz, 400 cycle drive. Power reliability is 30,000 hours at 60 rating. Engineered by ultimate performance engineers experienced in the most advanced missile programs.



ELECTRO-MECHANICAL DIVISION

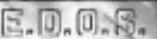
IRON CLOUT, EARTHTONE, MASTERS, & LEADS, SURFACE PROTECTANT, & SEALANT, ENGINEERING & DESIGN SUPPORT ELEMENTS
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A. O. Smith's exclusive



process shows way to conservation of critical metals . . . saves thousands of dollars in fabrication.

A-286 alloy ring for a finger of flame

Today, products are becoming increasingly complicated and costly. Further, there is a definite trend toward higher production in the sheet metal field.

That's where E.D.O.S. (Dissolved Dissimilar Aluminothermic) comes in—into your picture as speed wire, sheet wire.

The A. O. Smith process consists of:

Following flash fusion welding. With it, even the most difficult to weld metals can be joined. It's also ideal for joining the parts you need with only one grain flow machine in most cases. There's no wasted metal, no need for grinding or machining. You can expect to "weld" a part down to size. Parts cost savings of up to 75% have been reported.

A. O. Smith's 800-ton, single-action,

process-forging press is the only one of its kind in the country. There is 1,000-ton capacity, but it's the only one of its type and size in the country.

Since World War II, E.D.O.S. has helped make A. O. Smith a major supplier to the aviation, rocket, missile and related industries. A. O. Smith products are currently helping to accelerate the VANGUARD project.

E. D. O. S. applied to a jet engine case



This process fuses with a flame and other materials to produce a joint that is just as strong as the original process.



The joined two bodies produce one and no added heat is given in case of the overheat.



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ILLUSTRATED
BOOKLET.

bulletin 117A, an
illustrated booklet
designed especially
to inform you of the
advantages of this
revolutionary sheet metal
joining process.

Through research  ... a better way

A.O.Smith
CORPORATION

AERONAUTICAL DIVISION

Milwaukee, Wisconsin

These are the unjoined and joined
Metal machined live hardware.

...and this is what they look like after being joined. Below is a list of what can still be joined by the customer.

A. O. Smith Corporation, S.A., Milwaukee 1, Wis. 53204

TEMPERATURE'S RIGHT FOR THE CESSNA'S FLIGHT!



Harrison-angle-in cooler for all types of aircraft engines. No main heat exchangers are required, valuable and compact . . . important to provide the maximum in cooling efficiency.



**Harrison-Cooled Cessna, Fully Loaded,
Climbs 415 Feet Per Minute On One Engine!**

Ready for take-off — and Harrison's ready to take care of the heat! This ultra-modern Cessna 172-B, with a host of new safety features, relies on Harrison oil coolers for sure, dependable temperature control. Harrison heat exchangers are compact, lightweight, to save space and increase payload.

They're specially designed to do the job and do it better. And Harrison's in every type of aircraft, from supersonic jets to private planes. You can count on Harrison, with over 17 years in the manufacture of heat-treated equipment, for a top-quality product. If you have a cooling problem, look to Harrison for the answer.



HARRISON RADIATOR DIVISION • GENERAL MOTORS CORPORATION • LOCHPORT, N.Y.



AMERICAN AIRLINES FLEET NOW 100% EQUIPPED WITH BENDIX IGNITION ANALYZERS!



We are very proud that American Airlines has chosen the Bendix Ignition Analyzer as the standard equipment for its entire fleet of aircraft. On American's long-range aircraft the analyzer is permanently installed in each engine component. Telescopic mounts are provided for possible in-service inspection.

Scintilla Division
BETTER NEW YORK



American Airlines has used the Bendix Ignition Analyzer for quite some time. The decision to prepare the entire fleet of aircraft for use with this analyzer was made after long usage had shown this to be the most suitable equipment for American's requirements.

Major airlines, military services and corporate aircraft operators have found the Bendix Ignition Analyzer to be a vital and almost indispensable piece of equipment to reduce costs

by improving maintenance and operating efficiency. The analyzer plays an important role in reducing en route and turn-around delays due to improving customer convenience and satisfaction.

The Bendix Ignition Analyzer is a sound investment that will pay for itself within a short period. We would be pleased to provide complete information as to the most convenient and economical analyzer installations for your aircraft.

Birth
of a new
generation



Future jets will be flying higher and faster than any now in the sky. This new generation of jets will use radically new products now in the development stage at Ex-Cell-O—builders of actuators, valves, fuel nozzles, blades, rotors, fuel controls, parts and assemblies.

EX-CELL-O EX-CELL-O FOR PROGRESS

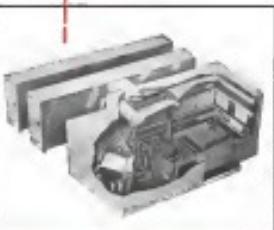
CORPORATION DETROIT 32, MICHIGAN
Aircraft Division

MAN AND MISSILE FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O



50,000 FEET UP-
with feet still on the ground

ERCO PROVIDES CRITICAL TRAINING
FOR CREWS OF THE KC-135



The recent photo-illustrating flight of the SAC B-57 at the average time of 45 hr to 10 min, could have been 5 to 6 hours longer if the all jet KC-135 had been approved to perform the refueling. Very soon the KC-135 will become fully operational and the crews of tomorrow's 500+ flight leaders will be fully trained — thanks to the ERCO Flight Simulator. ERCO — one of the recognized leaders in the field of synthetic training devices was selected to design and build the KC-135 Simulator.

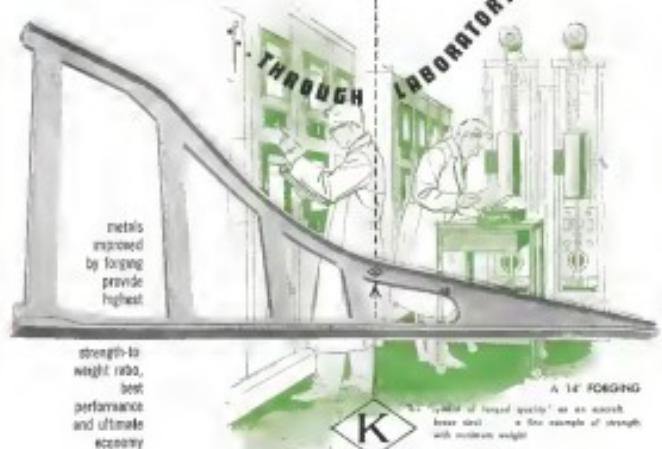
In addition to the KC-135 Floor Based Simulator shown here ERCO has designed, built and delivered more tankless flight simulators than all other manufacturers combined.

Let us help you with your training problem! Write today to ERCO Dept. MS, Rockdale, Md., for the brochure, "Synthetic Training Devices" and learn how ERCO crews can assist you.

ERCO

NUCLEAR PRODUCTS - ERCO DIVISION, OCF INDUSTRIES INC., RIVERDALE, MARYLAND
AMERICAN CAR AND FORGE CO. • AYRTON • CARRIAGE CARBONITE • CHRYSLER CAR LINE • H-C-M • ADVANCED PRODUCTS

QUALITY FORGINGS



"A quality of forged quality" as an aircraft, lower cost, a fine example of strength with minimum weight.

AT KROPP

continuous, all-inclusive quality control through modern laboratory techniques determines the best forging procedures and insures the production of forged parts to existing specifications. Before forging, through all production processes and after completion, forgings are constantly subjected to rigorous test and inspection. Such examinations control the inherent properties of heat-treat and grain flow ... the qualities of static strength or fatigue ... and the determination of impurities or hidden defects.

Quality control is one of the major factors in the production of metal parts at their best.

Forged parts that will serve you better. Our laboratory, part of our complete facilities, is at your service.

FOR PARTS THAT ARE ECONOMICAL

Kropp
FORGE COMPANY
CHICAGO 26 ILLINOIS



WEIGHS ONLY 22 POUNDS —DELIVERS 17 KVA

New Aeropproducts air-driven generator supplies emergency power in Douglas A3D and A4D

Now flying in the Navy A3D carrier-based bomber and scheduled for later versions of the A3D, this new Aeropproducts air-driven emergency generator provides the highest power-to-weight ratio of any unit of its type. Also capable of generating power for low-target scoring mechanisms, the compact, lightweight generator develops 17 KVA @ 12,000 rpm—provides adequate emergency power to operate lights, radio, instruments, trim tabs and elevators.

The same engineering know-how which has made Aeropproducts the leading designer and producer of turbo-propellers is available to assist you with the design, development and production of new air-driven generators and hydraulic pumps, actuators and other air-borne accessories.



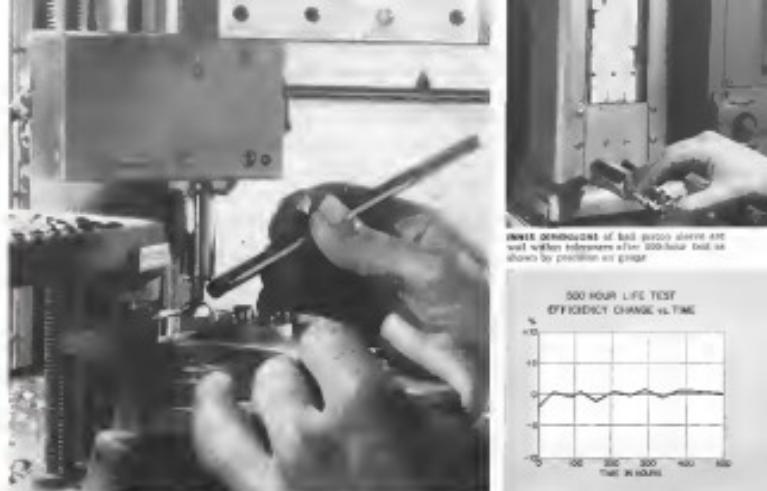
Using a simple blade pitch-changing mechanism, this Aeropproducts air-driven emergency generator goes up to speed in less than 1/10th second—gives an output frequency between plus 10% and minus 5% over a wide range of air speed, altitude and load conditions.

For detailed information on how Aeropproducts can assist you with your aircraft auxiliary designs, write on your company letterhead or telephone, "Aeropproducts Air Accessories" and new design catalog, "Aeropproducts Rare Air Accessories."

Building for today... Designing for tomorrow

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ALLISON DIVISION OF GENERAL ELECTRIC • DAYTON, OHIO



SMALL PISTONS used in General Electric Hydraulic Constant Speed Drives show little wear after 500 hours of continuous operation. Wear is so minute a highly sensitive electronic device is needed for detection.

GENERAL ELECTRIC CONSTANT SPEED DRIVE TESTS SHOW

Ball Piston Drive Efficiency Maintained Throughout 500 Hours of Operation

Last test data shows no measurable change in efficiency of General Electric Hydraulic Constant Speed Drive after 500 hours of operation. The drive was operated in a typical aircraft speed and load schedule with oil at temperatures from 216°F to 337°F.

PRECISE INSPECTION of the ball piston units—key to the smaller size, lighter weight and maintained simplicity of all General Electric Hydraulic Constant Speed Drives—shows why After 500 hours of severe laboratory testing, the distance between the ball piston and the sleeve showed no significant change. Based on those findings, General Electric

engineers predict that this same hydraulic constant speed drive could have been operated for an additional 500 hours with little or no loss in efficiency.

THOUSANDS OF HOURS of operational flying, plus their test results, prove the outstanding reliability and long life of General Electric Hydraulic Constant Speed Drives. These drives can be used with any 400-cycle a-c generator or generator, transformer, or loadgear system.

COMPACT AND SELF-CONTAINED, a 172 lb. and 28 KVA drive measures 11 in. long and 8 1/2 in. in diameter. It weighs just 21 lb. A typical 40 KVA drive measures 11 in., by 11 in., and weighs 33 lb. A self-

contained mechanical governor system provides steady state speed control to +1%. Frequency control is ±1/10% and automatic paralleling can be provided. For more information on these drives and other products of the Aviation, Aerospace, and Defense Division, contact your G-E Aviation and Defense Industries Sales Office, or mail coupon.

Aviation A-10-B, General Electric Co.
Schenectady 3, New York

Please send me literature concerning hydraulic constant speed drives.

Recognition bulletin, GEA-A204

Theory of Operation, GEA-O204

Immediate project References and

Name _____

Title _____

Company _____

City _____ State _____ Zip _____

Progress Is Our Most Important Product

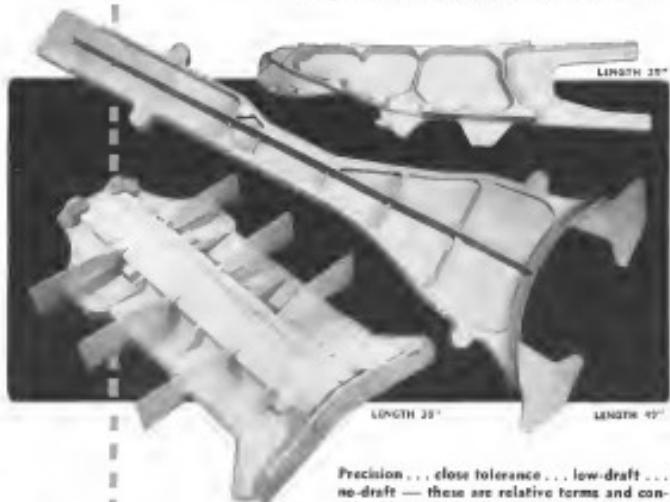
GENERAL **ELECTRIC**



G-E DATA shows no measurable decrease in efficiency at G-E hydraulic constant speed drives after 500 hours of operation.

PRECISION FORGINGS

By WYMAN-GORDON



Precision . . . close tolerance . . . low-draft . . . no-draft — these are relative terms and considerable confusion has been created because they have been loosely used. Close tolerances on large forgings have been pioneered by Wyman-Gordon over the years. The degree of precision which is practical now becomes a question of economics.

The forgings illustrated are typical of Wyman-Gordon close tolerance forgings that have been produced in quantity. In solving problems of tolerances, design and metallurgical quality, there is no substitute for Wyman-Gordon experience.



WYMAN-GORDON COMPANY

Established 1863

FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM
WORCESTER, MASSACHUSETTS
HARVEY, ILLINOIS • DETROIT, MICHIGAN

WHO'S WHERE

In the Front Office

George E. Carlson, board chairman, Minnesota Rubber and Canvas Co., Minneapolis; Alvin Robert W. Carlson, president, Minn. Carlson Carlson Co., producer of wire mesh.

William C. Carlson, senior vice president, Northern Kraft Corp., Stamford, Conn.

Richard W. Gilbert, senior vice president,

Alpha Industries Inc., Wm. Chester L. Miller, president, vice president/operations.

John M. Knobell, president in the glass and glass applications, Vitro Corp., New York.

William M. Coffey, executive in the plastic department, Hammar AutoGlass, Inc.

Charles V. Conaway, Assistant Director, Office of Air Traffic Control, Civil Aviation Administration, U.S. Department of Commerce, Washington, D.C.

Honors and Elections

William V. O'Brien, vice president of General Electric Company and general manager of the Appliance Sales Division has been elected president of the National Electrical Manufacturers Association, New York, N.Y.

Edwin Morris, Jr., chief electrical engineer of North American Aviation, Inc., has been named for membership in a Fellow of the American Institute of Electrical Engineers, one of the AIEE's highest awards. "The presentation of this award is an unusual achievement, engineering perspective to the design of electrical equipment for aircraft."

Charles E. Lindberg of the University of Minnesota has received the University Award for Research, which is given annually to one research education center making the greatest contribution to an air education.

Charles N. Kinsler, director of the Aerodynamics Laboratory, has received the Standard Climax Award for his outstanding contributions to the theory of the problem of supersonic flow. He is known as authority cracking a piston for producing nitrogen and liquid oxygen motor gasoline before power World War II as demands.

Changes

Dr. Noah S. Davis, director Space Propulsion Branch, Fluid Mechanics and Chemical Corp., Buffalo, N.Y.; Alvin John H. Korte, manager Chemical Department, and Ralph Sollner, manager Engineering Department, Westinghouse Research.

Robert G. Stott, assistant manager, 90th engine D-C office, The Ralph M. Parsons Co., Los Angeles, Calif.

New Miss George E. Menefield (USN) will, effective January 1, be vice president administrative manager, Inc., Link Trunk Division, Hicksville, N.Y.

Donald F. Rossau, general manager engineering and production, International Isolator Corp., West Seneca, N.Y.; Alvin K. Klein, sales manager.

[Continued on p. 311]

INDUSTRY OBSERVER

► Only 16 tons of fuel would be required to send a nuclear or gas-turbine pig on a 22,000-mile round trip. In this case, using an orbit calculated by computers in the University of Illinois Applied Astronautics Institute, a 100-ton payload of 500 cubic feet of fuel, fuel is recycled until its tankless, gravitational forces do the rest. Fuel load is 86,100 kg. Lowest approach to the moon would be less than 18,750 m. Trip out and back would require five days each and rocket would remain close to the moon for two days. Farthest distance from earth would be 263,800 m.

► Douglas Aircraft and Magneair are making a joint preparation to Bureau of Aeronautics for supersonic researches similar to those now carried by Navy anti-submarine fighters. Under Douglas/Magneair plan, bomb bay would be lowered into the water during a right turn. With a long enough line, bombs would then be released almost simultaneously in the water during the turn, or three groups of bombs and一枚枚 missiles needed to cover the area. Aircraft Douglas's could like be used if the project is adapted in 1966 Interceptor STOL aircraft (AW April 1, p. 29).

► Thirteen Remotek rocket used in first and second stages of USAMF's high-altitude rocket (AW Oct. 21, p. 30) and as propellant for Lockheed X-17 research vehicle had a thrust/weight ratio of approximately 100. Remotek is now under way in diameter, weight 196 lb, and develops about 15,000 lb thrust.

► Air Force is considering Chance-Vought Regulus II, 1,000-miles-range intercontinental missile as a successor to the 500-mile-range Martin Matador. Regulus II, developed for the Navy, is now being flight tested from Edwards AFB, Calif.

► Investigative gravity experiment being considered by Air Research and Development Command is University of Detroit project to build 4,000 lb aircraft which would be rotated at 100,000 rpm so that hypothetical existence of gravitite subspecies of matter under high acceleration can be passed to experiment.

► Flight test program of interstage conversion of Grumman Centaur space engines and upper stage to begin in approximately six months. Developed by McDonnell Douglas, Centaur-Douglas aircraft will have a supercharged 540-lb thrust, regeneratively cooled with freon and nine pitch propellers as replacements for the standard 440-lb Pratt & Whitney Wasp engines. Gross weight of the conversion will be about 11,000 lb as compared with about 5,000 lb of the original aircraft. It will carry 550 lb in fuel rather than the original's 120 gal. Aircraft will feature attributable winging float, piston instead and orbital wind shield.

► Some government is interested in limited purchase of Chance-Vought F8U-2 modified version of the F8U-1 (AW Nov. 18, p. 27). First F8U-2 is scheduled to begin flight tests this winter, and deliveries to the Swiss probably could begin late next year if Navy approved.

► Later in the trend by both U.S. and Russia helicopter builders to clean up their aircraft (AW Nov. 18, p. 24) is Shandor modification of the S-16. Company has used sheet metal rivet fixing to reduce noise but to improve top speed and engine economy. Apertures are left for rotor blades.

► AllResearch Manufacturing Co., of Los Angeles, is supplying hydraulic power source for Nike missile flight controls. A manoperated pilot as AllResearch's liaison coupled to a Victoria hydraulic pump which changes a bootstrap accumulator.

► Russians have been exploring possibilities of hydrodynamism nuclear rocket projectiles for several years. Technical literature also has shown their interest in fusion as an option. Research has included studies of thermodynamic properties from 700K to 5,000K of Ti, Si, Cr, Cu, Ni, and C.



HOW THE SILICONES MAN HELPED...

Build a Gyro for Straight Shooting!

An accuracy that could hit a .08 from a retiming roller coaster...—isn't something that can be had without impacting its operation. That's the "impossible" gyro control gear built by Minneapolis-Honeywell, Aerospace Division. Known as the HBC-5 (Honeywell Integrating Gyro), it's lightweight and small enough to hold in the palm of your hand; it supplies the "sense of balance" necessary at supersonic speeds.

Operating in a viscous fluid under wide bands of temperature and pressure—such can be no less than perfect. What material was used? "O" rings of UNION CARBIDE Silicones.

Fabricated by Minnesota Products Company, Racine, Wisconsin, these "O" rings were tested from -65 to +400 deg. F., at simulated pressures from ground level to operational altitude. The new "Silicones Man" is a good mark of 100%.

U.S. Patent 3,061,784. Division of Union Carbide
Canada Limited, Toronto, Ontario.

Under such rigid tests, Union Carbide Silicones Rubber showed outstanding sealing qualities and resistance to compression set.

This is another example of how the Union Carbide Silicones Man has helped solve an "impossible" problem. A booklet—"Look to UNION CARBIDE for Silicones"—describes silicone rubber and many other silicone products. Write Dept. AW-45 today. Silicones Division, Union Carbide Corporation, 30 East 42nd Street, N. Y. 17, N. Y.

UNION CARBIDE SILICONES

Washington Roundup

Balance The Budget

Statement is by White House, Defense Secretary Neil H. McCall and his Defense Congressman William J. McCall indicate that the administration has not relaxed its determination to balance the budget despite the acceptance of higher defense costs to meet the Russian challenge.

While the defense grand total with its re-knowledge that the Pentagon must have more money, both McCall and McCall have said to discount analysts that there will be a substantial impact. The Senator of Delaware, who will be reelected if he gets through the present fiscal year without spending more than \$18.5 billion, believes the fiscal 1970 budget will end up in the size of \$19 billion.

It is clear that accelerated expenses to push the inter-service range ballistic missile program and supply the weapons to U.S. allies abroad plus increased personnel costs and other rising expenses will make this difficult.

The armistice military installations are essential in nature; these will be charged back along with other activities not contributing to our technological race with Russia. Budget damage probably will be suffered by the Armed Forces, which explains in large part Army's current effort to publicize its capabilities.

Holiday's Role

Holdthorn's responsibilities of William M. Holdthorn as he will "discuss" all aspects in the Department of Defense relating to research, development, engineering, production and procurement of guided missiles. He also has a new title: Director of Guided Missiles instead of Assistant to the Secretary of Defense.

Holdthorn's authority does not extend to the budget, and it does not cover the administrative people which will fall to the powers of the new single manager for research and development (see page 28).

Holdthorn's role in Holdthorn's relationship with Dr. James R. Killian, now on the job is Vice Chairman of the Defense Science Board, is not clear. Dr. Killian is chairman of the Defense Science Board, which is a committee of scientists and engineers. Dr. Killian's name would not be spelled out, but Dr. Killian is retaining his position as which he needs to prove his worth. The Senator reported a suggestion that the White House technical expert were given added to the Pentagon guided missile programs.

Sharing the Burden

Bright Pentagon viewing of the economy was spending cutbacks and the depth to which they will be felt by subcontractors and suppliers, some price increases, as passing along at least some of the financial burden will be financial.

One group in the socially conscious has told its supplier that the Defense Department spending cutting imposed with an appeal to economic stability can "become in order to keep total government obligations within the debt limit." The contractor's other:

"In order to meet these imposed financial burdens we feel of necessity, to take a percentage of unexecuted contracts."

When the military services review their usual procurement schedules, which is estimated to be about July 1

1970, we will return to our usual price processing of contracts.

Airlines View Sputnik

Sputnik is having a disrupting effect on airline plans to launch their freighter programs set against the transport nation for Air cargo has planned to put the airlines program with other transportation organizations, the aircraft route. In other short range, obviously, the fax enroute. A fax reduction would partially offset air flights a fare zone would have on the traveling public, helping to prevent the loss of revenue needed public gas. However with the new capacity in a mobile defense program actions can lead an effort to reduce fares, probably will be started effort.

Re-Entry Solved

Watch for further forecasts over Army alone, served by President Eisenhower, in his Nov. 7 "cross speech from the White House, that it has solved the reentry problem for ballistic missiles.

Both Army Secretary Wilber Brueck and Maj. Gen. George McNamee, Robbin's Aerial base, have reiterated the statement that the Jupiter C can prove Army's theories have been proved.

Subject will be pushed at Senate Armed Services Committee hearings on Capitol Hill which are scheduled to begin early, when other legislation is expected to challenge the Redstone claim.

Offer to Capital

Independent Airlines Asia, representing 29 supplemental carriers has offered to fit Capital Airlines costs without the addition of airline funds. The group and it had asked for an increase of 10 percent of federal subsidies, or, if we're ready to fit Capital's shares on the company. Capital Airlines added to the Civil Aeronautics Board's efforts to reduce its portion of participation because of its critical financial condition (AW Nov. 13, p. 26). Meanwhile, Capital is offering American Airlines request to subscribe in the ordinary case as grounds that its right to subscribe is governed by the Civil Aeronautics Act and not by the possibility that American has not decided that the legislative permission for subsidies as long as complete five years. American's request to subscribe was filed before, according to the carrier, the Capital petition gives a basic provision of public policy. Is it in the national interest to put individual carriers against established carriers? (AW Nov. 13, p. 39)

Defense Definitions

Defense Department last week described what it means when it reports that a missile has lost "in area of impact" and when it has hit the target area. "Area of impact" is defined as an area about 2.5% square miles. This was reported to Rep. Dan Faust (D-3-1) after he suggested that a 4% could mean an area of 10,000 square miles. The Department said its "target area" means an area "only a fraction of the size of an impact area."

—Washington staff

Single Manager to Head Anti-Missile Push

Army Zeus, USAF Wizard projects will be combined under single manager; other projects to follow.

By Claude Witte

Washington — Following a White House review, Defense Secretary Neil H. McElroy has added the next missile will appear a single manager, his spokesman said, and development, or weapons systems, handing over the anti-missile work as the first project for the new office.

Both Army's Nike Zeus and USAF's Wizard project will be consolidated under the single manager, who will have control of personnel, budget and research, development, analysis and procurement.

The anti-missile missile, "Machlo," made its debut in June, the first of the approach of two weapon projects that will be shown to the Senate Armed Services subcommittee through the research and development phase.

It is referred specifically to future strategic, launched-for-war, ground-to-air missiles and includes the new single manager title change.

Although details of the program change were lacking in all the just now Pentagon officials, it appeared clear that the idea will be carried out in contradiction to more accepted facets of the weapon system concept.

In addition, if approved, status is to fall opposition from anti-ballistic and missile sources.

How McElroy Views System

The Defense Secretary, acknowledging that details of the single manager idea will soon be worked out, described the idea in these words:

"Defense Department did not try to develop weapons or the field."

"It will do research and development to the point of operational capability—because these weapons are not built in combat situations. It has an always-with-the-service connection."

"Object is to avoid competitive effort by services because the weapons are developed simultaneously by all the services."

"New weapons will be turned over to an operating branch of the armed forces when they are about to become operational, and as far as possible included."

"Single manager will assemble a fresh combination and research and development effort with those people who have been working in these areas in the past at the services."

McElroy's announcement followed by a week a statement by President Eisenhower that new programs will be

put under a single manager and of transferred without regard to the service service."

It was clear that a strong comparison between the Air Force and Army was the anti-missile missile would break into the open unless sharp executive action was taken.

McElroy's announcement was immediately by a man of status of that project in the otherwise missile field.

One report and the Army has Nike Zeus "in hand." It developed that this means the weapon "partially exists in the form of research and development components."

Nike missiles thus far are given to a number of Army, Coast Guard, Navy, Marine, Air Force and USAF and the Joint Chiefs of Staff in the Army speed more than 500 miles per hour and enough progress to perfect the interceptors missile. Both Machlo and the Joint Chiefs denied the report.

Service Confusion

A spokesman for McElroy told *Aerospace Week* that the single manager proposal had been discussed with the armed forces at a meeting attended by

the Chiefs of Staff and others.

At the time, both both USAF and Army personnel is high as an informed source expressed concernment when it was called that this situation that the two separate missile projects will be taken over by Defense.

Five days after the McElroy announcement, an Army officer said: "The thing went right over my head and I am one A & D people that I know about it either."

On the other hand Gen. Taylor was reported to be aware that his program would probably come under the direction of a single administrator for all three services.

Others here were of the opinion that, once the word gets down to the operating personnel, there will be no hard feelings against the change.

Industry Apprehension

In addition to the military who will lose control of parts research and fabrication to a new entity reporting to Machlo, industry contractors already are showing signs of apprehension.

In particular aircraft industry, prime contractors already have signed their agreement to the "several concepts" of development, and this can be expected to favor a good the new single manager concept for the same reason. Primeurs, this involves the cost and dissemination of an idea how the plant of its development to the plant of the producer.

The idea of this civilian offices in charge of research, maintenance and production and service, almost certainly will then concern every manufacturer in the area who wants access to a market branch of the armed forces when it is about to become operational."

On the surface, this would appear to ignore the fact that this new agency will be responsible and defend the capabilities of a new weapon.

In the Air Force, for example, the development cycle starts with a General Operational Requirement (GOR) statement, the long continuing to increase in the form of Weapons Systems Project Office (WSPD) from the time that the design first goes on paper and long before meant a cut.

Typically, there is a great deal of research to be done before problems of training, logistics and maintenance can be fully faced, and the time consumed in this work can take as many months as it takes to get a full勃 of the weapon out of the manufacturer's plant.



F-107 Turned Over to NACA

North American F-107A fighter-bomber, canceled before reaching production in USAF, has been turned over to the National Advisory Committee for Aeronautics High-Speed Flight Service (AFB). Cited: NACA will evaluate its remaining vertical tail, overhauled engine and gear for later rated fighter aircraft. F-107 is capable of Mach 2 in level or inverted climbing flight and will exceed Mach 1 in a vertical climb. Maximum air speed is over 1,300 mph. It is powered by the Pratt & Whitney J75 rated at more than 20,000 lb thrust. Like its predecessor, the F-105, the F-107 has variable leading edge slats and all-variable horizontal stabilizers.

Best contemporary example of this is the long program carried out by the National Committee to provide a supersonic fighter for operational battlefield use. AFB, Air Materiel Command, has a similar program for its fighter-interceptor program, but the project will emphasize spans mobility, for the operating forces.

The McElroy spokesman indicated that the administration does not consider these efforts as serious competitors to putting research and development of new weapons under a single manager.

There was some speculation that inter-service rivalry over the development and use of new weapons was not the only situation behind the White House Pentagon decision to turn to a single manager.

Swiss Hunter Order

General-Schweizerische Eidgenossenschaft has been asked to bid 100 Hawker Hunter F.6 aircraft for 1959 delivery as a first step in re-equipping the air force.

Choice of models with proposed light on for the Swiss air force has been narrowed down to the Hawker Hunter and the Saab-Jet. F-106 (IAW Sept. 16, p. 68).

Another possible bidder was a consortium early this year that all research and development funds be appropriated to the joint office of Defense and programmed by its office. The proposal advanced before the House Committee on Appropriations by the U.S.

Chamber of Commerce (IAW May 20, p. 25).

The Chamber, intent upon slashing the Defense budget, managed to score the Army, Navy and Air Force to the extent that the joint committee agreed. This included a proposal for the Chamber's confirmation that if research and development were properly integrated, the elimination of duplicate analysis, implicit building of logistics and staffing of such installations might well bring substantial savings to the taxpayer.

Nothing has been heard of the Chamber's suggestion that there be control of research and development only in the office of the Secretary of Defense over the executive hearings, but it is possible that the idea has been presented strongly at the White House.

Missile Blackout Blamed on White House

By Katherine Johnson

Washington—Evidence that President Johnson has been only sketchily briefed on missile programs since he got in and that the White House directed a total blackout on the issue of missile information was presented last week at sessions of the House Information Subcommittee. Members behind the blackout according to the subcommittee's Robert Carter, the President's special assistant for national security affairs.

John Gardner testified that during his three years as Assistant Secretary of the Air Force for Research and Development from 1955 to February, 1960, the President was briefed twice on USAF missile programs—an 18-month interval and at another meeting which took place right in our office.

"No Publicity"

Gardner said the Air Force was instructed to prevent the President's staffers, not problem. He said the President wanted no publicity on guided missiles and that "almost every time missile information appeared in the press there was a complaint from the White House."

Rep. John Vass (D-Calif.), chairman of the subcommittee, later named Robert Carter as the person most responsible for the missile blackout. Noting Carter's role in the 1960 decision that each of Mr. Carter's staff of eight would be limited to two visitors without Air Force Security, Vass said Gardner found that Mr. Gardner repeatedly opposed public information about the nation's missile program.

Two major developments were



TREVOR GASHIER

• Official documents indicated Gardner in a short talk with Alonso Sayles, Associate Secretary of Defense for Public Affairs, was told by Gardner to "remove all references" and that "almost every time missile information appeared in the press there was a complaint from the White House."

Gardner testified that he was informed by President Eisenhower before authorizing him to make a speech in May, 1955, specifically despite the fact that his remarks had been referred to the Department of Defense. Under both Presidents, he said, the missile situation was handled in the press conferences.

Actually, a Department of Defense press release on the ICBM was issued 10 days before Gardner made his speech in Dayton, Ohio. The release was aimed to coincide with the speech. Alarmed "Hush" for release until 10 AM, (1971)

Atomic Plane Acceleration

Washington—Administration, convinced there is a strong possibility that Russia may be a nuclear power shortly before the U.S. completed with a program, did not suffer the setback of the Sputnik satellite, is acting to accelerate its program.

Defense Department and the Atomic Energy Commission have now spent to give \$100 million. Gov. George K. Ross has obtained authority over the project and another \$100 million will be available.

AEC decided last week that it spent \$60.7 million in fiscal 1957 on aircraft production research and development. This was 67% above the \$92 million figure for fiscal 1956.

Spending for construction work, including the program jumped last year to \$6.2 million up 155% over the 1956 total of \$2.4 million, indicating that the program will be further accelerated.

There is opinion in the Air Force that the operational problems associated with the atomic airplane are so significant that the project does not deserve a top priority. However, drafting of an air rule to facilitate the work is under way by the political administration as a sensible effort in the light of the new safety law that technological advancements carry weight in world affairs.

Mar. 12, the Defense Department released a memo: "Now the Defense Board directed by Secretary Gardner and approved a total blackout on the issue of missile information was presented last week at sessions of the House Information Subcommittee. Members behind the blackout according to the subcommittee's Robert Carter, the President's special assistant for national security affairs.

Defense Department officials also initially approved a Mar. 15 release of bulk general information on the ICBM to Hughes Aircraft Co.

• Subsequently began an investigation of the practices of the Operations Coordinating Board at the White House which establishes final policy on missile information. More reported that the subcommittee will discover, for the first time, the part played in this highly classified agency within the White House which appears in editing the speech and that the American public will be told the Administration's position with regard to the publication with Britain.

Carter, a vice

• Chairman John E. Moss (D-Calif.) and his colleagues who attended a closed dinner for the Commerce Department's Economic Advisors Council Oct. 25 have told the subcommittee Carter changed his signature with regard to a great diversity in the nation, and suggested that businesses take the president's slogan seriously and redesign their place there advertising.

Carter is chairman of the National Science Council's Planning Board, and a member of NSC's Operations Coordinating Board and the Council on Fair Trade Practices.

• Testimony continues regarding Carter's remarks in the closed meeting Carter dinner through White House Staff Secretary James Higginbotham. He had second Atomic Energy Week of nation's redesign of the nation's

• Gardner reported that he "knew

from the beginning that each of the three services had banned comments on satellites for fear of counterintelligence," shortly before the launching of Sputnik. Rep. Eugene Tingley (D-N.M.) insisted that "nonsense" and said Gardner had lied.

• A memorandum of USAMR & Development Command stated that "the President does not like personal criticism on the subject of the U.S. missile program," (AW, Oct. 21, p. 28).

• Sayles said the subcommittee set to press for declassification of information on the aircraft development program in which Paul Anderson, Air Force Secretary, participated, beginning shortly before World War II. This could include "grave security consequences to the U.S.," he said.

• Sayles told the subcommittee he had protested the issuance of a memorandum in ARDC which directed that public statements not be made which may prove embarrassing.

He also pointed out that months before the Sputnik launching, the Rev. Dr. Martin L. King, USAF chaplain, informed him that Boston churches and places (see page 38) "What the Air Force did with it, we do not yet know," King commented. "But we do know that the American people were never informed."

Information Reg.

Other testimony before the subcommittee included:

• Both Fariss and Gardner signed a Defense Department wide system of security clearance and clearance of the need to know" implemented for assistance to classified information. "It has been what says them, you wouldn't need to know," Fariss said.

• With publication, Fariss recommended an increase in the exchange of information among the services. Fariss reported that there was a chain of several months in the inter-service exchange program and the anti-submarine warfare program in progress, joint briefing sessions. He said he intended to use his authority as Assistant Secretary of Defense and "go to the limit" to force inter-service cooperation. He continued, however, that informal exchanges in the planning stages could be "less formal and could involve such a grant of information that the value would be determined" to progress. Gardner suggested that "sometimes it might be a good thing" not to exchange information among the services, adding that the strengths of cooperation should be weighed against the risks of exchange of information, he continued.

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the ARDC order showed "lack of judgment," was contrary to "specific direction" of the Secretary of Defense, and that the individual responsible should be "responsible."

• Vice Adm. John M. Hawkins, director of declassification policy for the Secretary of Defense, reported that he wants to have all information pass to

Jim J. 1966, automatically declassified. He said that under such the number of Defense Department personnel required to engage the "top secret" classification has been reduced from 4,672 to 325. To facilitate future declassification, he said previous classifying documents are required to explain their "thinking" in rating a classification.

Cutter Denies 'Boycott' Accusation

Washington—Robert Cutler, special assistant to the President for national security affairs, has formally denied to the House Communications Subcommittee that he caused Atomic Energy Week of nation's redesign of the nation's

• "I did not state that any advertiser should boycott the magazine."

Meetings

Rep. Max and the main public the correspondence with Cutler of the 1960's in evidence of the press after the subcommittee staff had checked with members of the council that he attended the dinner.

These present (at the dinner) report that Mr. Cutler did not speak the publication," Max said. "The date in question had been front page news in virtually every newspaper in the country a few days before, and the newspaper prominently identified the journal (Atomic Energy Week) in the cover of the publication about the missile tracking station in Texas.

In questioning Mr. Cutler's remarks, Max asked if he had not been given advance warning of the publication's information disclosed.

He responded, "I'm afraid official alibi that this has been an association and disclosure of properly classified information, has been given notice of action to make his cargo ship and take the steps disclosed in law."

The question coming in a scroll of Mr. Cutler's remarks illustrate the bulk of senior government officials in the Bureau of Budget Affairs Council. This scroll is reflected as general that the group received an often confidential advice from the bureau chief at off the record meeting.

• When agency is intended to disseminate meeting at which government officials are enabled to make remarks for which they are not publicly accountable the argument for senior government members.

• Max blames Cutler for much of the unnecessary secrecy surrounding U.S. military program (see page 28). Max said and Cutler always credit for having established the Commerce Department's Office of Strategic Information to review classified information. This office was abolished following their obsolescence in Congress (AW July 1, p. 25).

Red Sputnik Plans Available Last June

By Everett Clark

Washington—A significant date of the history of Sputnik I was revealed by the U.S. government in an official report written last June 21 and which was published in Sept. 1 *Sputnik I* was first into orbit on Oct. 4.

The same report pointed out that Russia was about certain to reiterate its "priority and pre-emptive value to be granted" in launching an earth satellite ahead of the U.S.

President Eisenhower said at his first post-Sputnik press conference on Oct. 9 that he had no advance information that a Russian satellite launching was imminent.

In view to precisely monitor the Russian program and provide joint information to the public, the government and associations that the Soviet Union was about to do illustrates one of two major problems in the scientific and technical information fields:

- Failure to acquire, index, classify, select and disseminate promptly the vast amount of scientific technical data now available in this country and abroad.

- Failure to act on it promptly once it is acquired.

Reader of *Russia's* interview to make the greatest political use of both unclassified advancements in the Intersatellite Geophysical Year, especially in astronomy, has been abundant and has reached fine measure in quantity.

Read Monitored

The prediction of the "darker possibility" that Russia would attempt a satellite launching on Sept. 5, was issued in a Research Memorandum (RM) written by F. J. Krueger and published in the Rand Corp. *Astronomy* sponsored short research by Air Force and the Atomic Energy Commission.

Advantages to be gained in being first with a satellite, percent a Kremlin stance for its initiative for the upper hand in the Kremlin to quash, Krueger suggested.

Krueger's memorandum in Part II of *Astronomy* on Soviet Astronautics. It quotes Academician A. N. Nesmeyanov, president of the USSR Academy of Sciences, as saying in Kremenchuk, Ukraine last June 9 that "you, basically, within the next month, can place earth satellite, whether you like it or not."

The technical difficulties that stand in the way of the actions of this prediction can best be assessed by our scientists. The argument by means of which the estimate had apparently can be tested has already been made.

Eight days earlier, in Tverda, Nesmeyanov had said: "At a result of many years of work by Soviet scientists and engineers to the present time, rockets and all the necessary equipment and apparatus have created by means of which the problem of an orbital earth satellite for scientific research purposes can be solved."

Soviet Astronautics

"This an extensive series of recent Russian technical and popular literature," Krueger reported, "the 'darkest possibility' that the Soviets would try for Sept. 17, anniversary of the birth of Russian astronomer Galileo Galilei.

According to Krueger, "though

it comes rather early in the current EGY," one factor supporting this conclusion, he said, was participation of the living of the first *Pioner-Vanguard* satellite to late 1957 or early 1958.

So much before Part II of the *Cosmos* was written, Krueger reported in Part I (RM 1786) that three basic reasons probably were behind Russia's increased effort to publish its interest in astrophysics and the fact of these reasons was propaganda.

Russia does not publicize the contents of its research manuscripts, but there is little doubt that efforts connected with Project Vanguard and various U.S. missile programs received

wide distribution in space flight literature, as well as in scientific journals.

Tsiolkovskii: 'Earth Is a Cradle'

Washington—Russia's interest in space flight begins with her 1926 Cosmonautics Katherine Tsiolkovskii who said: "The earth is a cradle of the mind, but we cannot live forever in a cradle."

But critics of the Soviet Union's space effort and some defense interest in cosmic conquests date back to Nov. 27, 1915 when Artyomovna A. N. Nesmeyanov, president of the U. S. S. R. Academy of Sciences, told *Le Monde Populaire Soviétique* in Moscow: "Russia had reached a state where it is feasible to send a state due to the world, to create an artificial satellite of the earth."

This estimation was "too rapid to begin widespread publication of articles and books on space flight," according to F. J. Krueger of the Rand Corp. In Part II of a classified *Astronomy* (RM 1781) Krueger lists subsequent events that made Russia's interests quite clear. A summary follows:

- **F. I. Tsiolkovskii** Gold Medal, established Sept. 24, 1954, by the President of the U. S. S. R. Academy of Sciences for outstanding work in interplanetary communication to be awarded every three years beginning in 1957.

- **Committee on Interplanetary Communications** established by the Presidium as a permanent interdepartmental panel directly after creation of the Tsiolkovskii Medal to coordinate and direct all work connected with solving the problems of establishing interplanetary communications.

- **M. U. L. Tsiolkovskii** Gold medal hydrodynamics was awarded chairman and M. K. Tikhonravov—who designed and successfully launched liquid propellant research rocket in 1949—was appointed vice-chairman.

- **First Soviet dirigible** Sadi and K. P. Oreshnikov, an English-speaking aerospace professor from Lvov State University attended Sixth International Aeromarine Congress of Orbetello on August 1951. This was the same month the U.S. announced its *Pioner-Vanguard*.

- **U. S. S. R. Academy of Sciences** applied for membership as the International Astronomical Union in 1956. At the Seventh Congress in Moscow in September 1956, the application was accepted and the low Soviet delegate—Viktor Spitsyn—was elected an IAU vice-president.

- **Ulyanovskeron** invited last December when Academician A. A. Blagonravov, aerospace specialist and Pasadena member had a discussion of 25 scientists in the First International Congress on Rockets and Guided Missiles as Paris. Summarizing some of the papers presented Blagonravov wrote in Sept. that Russia's investigations in terms of rockets began in Russia in 1947 that stampede recognition studies to 100 tons altitude began in 1949, and that aerospace studies of the atmosphere, including the use of dogs, were conducted from 1951 to 1953.

Many experts disagreed last June concluded that Russia might well attempt to launch its first satellite on Sept. 17 of the year. The 100th anniversary of Tsiolkovskii's birth date, partly because the posting and propagation value to be gained from a precise launching of an earth satellite whether performed or not, reasonably posed a consideration to too attractive for the opportunity to the Kremlin to ignore.

the report titled Part II of the *Cosmos*.

Armed Services Technical Information Agency (ASTIA) also listed the report as ASTIA Document Number AD 151813. The report is considered a working paper that may be expanded, modified or withdrawn at any time. Views contained and recommendations expressed in it "do not necessarily reflect the official views or policies of the U. S. Army Forces," the report says.

In addition to comments on satellites, the technical and scientific papers covered in Krueger document *Planetary Research in Space* focus those rockets, missiles and space stations and interplanetary flight.

Russian technical literature on astronomy also contains "a wealth of evidence of native competence" and clearly indicates that the Russians possessed a relatively high degree of technical sophistication when than two decades ago, Krueger said.

One more paper, which Krueger said is "probably the best and starting document in connection with Soviet space flight activities," speaks of 600 test flights by Proton in 1958 as calculated by computer in a broad study.

Although the Krueger study represents good descriptive and quick summaries and distribution of technical information, it is not typical of the general handling of such information in the U. S.

A study of Russian and U. S. programs written by Jenkins and Berndt Closson and printed in the current *Central Federal Journal*, claims that:

- Russia will soon surpass us in her own scientific, technical and engineering information than the U. S. and makes more and more open to U. S. information than the U. S. does.

- U. S. has no central clearing house for such information, says through influence for it has existed for 11 years by executive order and for arms control by legislative act.

Russia's information institute, created at 1952, has a permanent staff of 2,500 translators, librarians and publishers, supplemented by more than 20,000 computing, professional scientists and engineers throughout the U. S. S. R. who are engaged in translation and extraction in their specialized fields, the Cleaver study shows.

The article publishes 11 "abstracts" containing 400,000 abstracts pulled from more than 10,000 journals from more than 40 countries. Since 1,000 of the 1,800 scientific journals published in the U. S. are translated, reduced and abstracted. Perhaps most useful are the 20 "Express Information Centers" designed to give key Soviet scientists and engineers summaries of



Army Unveils Satellite Plans

Los Angeles—The first details of the first batch of its satellite project and details of the successive installations, here lead by Dr. William H. Pickering, director of the California Institute of Technology Jet Propulsion Laboratory, Shirley Hill and engineer from the first stage of rocket a modified Avco-Japan C. Instillation known, Stage 2 or Navy Vanguard program designed controls for carrying on study a slightly over a foot long and weighs 20 lb. Jet Propulsion Laboratory, a placing site is Army project similar to that predicted by Naval Research Laboratory for Vanguard.

Foreign technological developments within two or three years:

- At least one U. S. scientific federal both programs in both countries has proposed a comprehensive plan for improving this country's program.

- Creation of an expert abstract service for civilian or defense research and development.

- Increased federal support of scientific journals and abstracting services now close to a small degree by scientific offices in the various

Volume of literature has doubled each 10 to 15 years since 1950, Pickering says. Example of the problem that results. A series of 180,000 scientific papers showed that about a fourth were abstracted as average of 2.5 times each, and about half were never abstracted at all.



PROTOTYPES demonstrated to agricultural pilots include (left) a single-seat with dispensing water吊桶 and sprayer with underlying nozzle. All metal fuselages have removable panels to allow maintenance access to clean internal structure of chemical containers.

Grumman Biplanes Probe Spray Market

By Craig Lewin

Dallas—New agricultural airplane designs specifically for aerial spraying have been demonstrated widely to aerial applicators in the South by Grumman Aircraft Engineering Corp.

The prototypes of the Grumman biplane were demonstrated to operators in Arkansas, Mississippi, Louisiana and Texas during a tour that started in Dallas and wound up at the National Agriplane Trade Show Nov. 10-12.

No definite production plans have been announced for the aircraft, but the company figures it would take about a year to roll out the first production model. Costs could vary, but under a \$1-million-a-unit basis.

Two Prototypes

Grumman has built two prototypes of the new airplane, one for spraying and the second for spraying tank and storage of the same liquid insecticide. A biplane powered by a 210-hp Continental engine and designed to carry 1,000 lb of payload. No price is quoted, but the sprayer will probably be in the \$15-25,000 range.

Wing span is 35 ft 8 in., length 26 ft 4 in. and maximum height 10 ft 9 in. The single-seat gross weight is 3,600 lb, empty weight is 2,075 lb. (Empty off-wt is 24 ft H, 217 gal) and the heavier load limitation is 1,000 lb.

New sprayer is an experimental status now, but it will be conformed under Part 5 of the Civil Air Regs.

Grumman says maximum speed is 115 mph and stall speed is 38 mph. The aircraft will take off in 310 ft weighing 2,300 lb or in 600 ft at 1,000

lb. Gross weight is 3,900 lb; gross weight, Rate of climb is 1,010 fpm, at 2,300 lb and 540 fpm at 3,900 lb.

Endurance is rated at three hours with the Continental 210-hp engine at 1,793 rpm. The airplane can use a variety of sprayers, including simple overhead nozzles, and this is a vital air economy feature. Another economy aspect is a lower fuel cost overhead cost on the low power (220 to 300 hp) compared to high power.

The new sprayer has sprayable loads. One prototype has external wings, the other has wings that are sealed on top and bottom underneath. All control surfaces are fabric.

Model 141 has removable panels and the Grumman 141 can be taken off in 30 sec to two min. This feature makes the aircraft easier to access for cleaning.

Tank load carries 14 gal and is in the center section of the upper wing. Upper and lower wing panels are interchangeable. The Grumman 141 has a 100-gal liquid storage tank. Wings have fold storage along with a steel bungee chord system. With the centrally located wings, all that is necessary is to lock them to the center section and the aircraft with simple rigging.

Describing the virtues of the biplane design, Grumman says it has a low stall speed and a gentle pitch. The biplane configuration provides good stall warning and the flat wings provide plenty of controllable aerofoil to absorb energy in a crash. This also provides protection against severe low level operations.



SPRAY VERSION of Grumman agricultural plane tested last at Red Bird Airport, Dallas, Tex. High-speed cropduster version after two to three flights in each. These earlier Aviation Week photos were made during demonstration flights on market survey runs.

Grumman also has a shorter wing span version after configuration flight.

Grumman also notes that the spraying nose and the normal flight attitude with the pilot sitting high provide good visibility. One pilot estimates that the ground can be seen 60 ft in front of the aircraft.

The new sprayer has sprayable load, leading gear. The biplane pilot selector control is at the ground rather than the center of general landing.

Prominent safety features in the design is a large location spray behind the cockpit. The location has an over turn structure so it can catch precipitation. The structure is a steel trap which is an extension of the basic structure and it has a 6 in. x 10 in. slot cut out of it. It is designed to keep the plane from getting "closed off" in certain climb situations.

The cockpit seat, shoulder harness and overwing struts in the Grumman biplane are stressed for 4G's.

Hyper Loop

The biplane and all equipment are derived from the pilot in the new airplane and the biplane is removable without detaching wing rigging. A full thrust climb rate can easily lift the biplane in maximum rate. The same biplane is used for both spraying and driving and can fit the external gear arms for the different jobs.

Grumman says aerial application would be able to choose between location spray, boom or exposed trailing edge boom. Clearance of the airplane between spraying and spraying gear is estimated at two to three inches. Small propeller drives bring outside the fuselage power the biplane

equipment, act as a pump for the spraying gear or as a motor for the spraying spender.

These instruments have been mounted outside the cockpit on the prototype, although Grumman says a more integrated system can be developed. This biplane would be the prototype model or next Aeroplane indicator and instruments are mounted in front of the biplane deck, which is in front of the cockpit. Fuel flow is measured below the fuel tank under the center section of the upper wing. Purpose of this outside location is to enable the pilot to check these effaced instruments without having to climb down into the cockpit.

To protect the aircraft from corrosion, all surfaces are coated with Fusion base coat paint. This paint is manufactured by Texas A & M College, which has done extensive research work in the field of spray painting and spraying. The cockpit seat, shoulder harness and overwing struts in the Grumman biplane are stressed for 4G's.

WADC Takes Action On Data Link Studies

Washington—At least 25 agencies concerned with communications are invited to submit proposals this week to the Army Modernization Board for experimental automatic data processing and display system (AV Sept. 30, p. 29).

Sperry Rand, Radio Corporation of America and Aerospace Electronics Laboratories have formed a team to submit a single joint proposal, with Sperry serving as the prime contractor. Philco and Westinghouse proposals will also submit a joint proposal. Hughes Aircraft Co. and International Business Machines Corp. each are expected to submit individual proposals for the contract job.

Army Modernization Board says the agency hopes to pick a winner by mid-December or by early January at the very latest.



LONG-RANGE radar developed by Lincoln Laboratories for ballistic missile defense system is now in operation near Boston. Radar employs 84 ft dia parabolic reflector.

Long Range Radar Spots Sputniks

New York-Hughes experimental ballistic radar developed by Lincoln Laboratories to track ballistic missile defense ambitions has successfully detected both Soviet earth satellites at remote distances. It was recently test used.

New radar, now in operation at Millstone Hill, about 10 mi north of Boston, apparently has also tracked Soviet missile fired at 11 Churchill in Canada approximately 1,250 mi away.

Millstone radar employs an 84 ft diameter parabolic reflector which can be rotated 360 deg in azimuth and elevated from the horizontal to the zenith. Reflector is mounted on a steel tower 90 ft high. Continuous high power transmissions are made possible by specially designed linear tubes operating at 11.8 GHz.

Special transversely digital computer, designed and built at Lincoln Laboratory, processes radar returns received on a multistage basis at an

intermediate frequency. An integrated computer is required that approximates target location for launch in order to calculate correct return steering pulse.

In each Sputnik sighting, radar direction finding techniques are employed to establish correct bearing point for the Millstone radar. During the process of infrared illumination to detect Soviet satellites with relatively broad fields of view, rugged flat panel devices might be housed with the Millstone radar to provide such viewing information (AW Nov. 4, p. 31). Small light-weight infrared scanning head can quickly search large area whereas the rotating portion of the Millstone radar weighs 90 tons and requires a considerably longer period to cover a similar area.

Laser, I-beam, and ultrasonic wave pulse will also be used to make "false" effects of motion with the same.

Technique Cuts Cost Of Memory Element

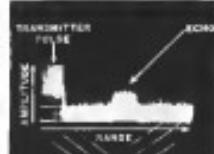
New York-Bell different type of reproduces computer memory element which is far more simple and less costly than fiberoptic has been developed by Bell Telephone Laboratories.

The conventional magnetic core memory uses a technique employing mesh of vertical and horizontal wires. Important difference is that new Bell technique, called "Twister," eliminates the mesh entirely and with that, the difficult problem of connecting horizontal and vertical wires through the cores.

Memory area made by the Twister technique consists of numerous mesh of horizontal wires made of copper and vertical wires made of magnetic material. Twisting applied to magnetic wires shifts the preferred direction of magnetization from the natural longitudinal path to a helical path. Consideration of both current and longitudinal magnetic field can thus result in a unique form of polarization that was in the form of polarized helical polarization and the magnetic core itself can be used as the writing memory.

In order to store an information bit it is necessary to apply two successive low current pulses, one to the appropriate copper wire, one to the appropriate magnetic wire. Information so modulated is decoded by considering the magnetic field in reverse direction and signal is obtained across magnetic wire. Output signal is somewhat larger than input pulse amplitude Bell says.

Lincoln currently is investigating optimum size and composition of magnetic wires for new memory element. Dimensions as small as 0.008 in appear feasible.



SPUTNIK I AND II have been detected by new radar. It records distance to sun, solar flares, etc.



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ON GUARD IN CANADA...IN EUROPE... AND FOR THE FUTURE...THE AVRO ARROW



From the first flight of the Mk I CF-105 in 1958, the development and performance of this all-weather interceptor for the Royal Canadian Air Force has won for it the role of front-line defender in North America and Western Europe.

The Avro Arrow, recently unveiled, begins an intensive pre-flight testing program. Under development for the interceptor role of the RCAF in the new North American Defense Command, the Arrow will have superior mission capabilities.



AVRO AIRCRAFT LIMITED

MALTON, CANADA

Congress Ready to Vote Funds For Priority Items, to Cut Others

Washington—Congress appears to be willing to vote funds for the fiscal 1959 budget required for high priority defense programs, but there will be strong pressure to postpone or abandon less priority military and civilian programs.

Commenting on the U.S. spending last week, Rep. George Mahon (D-Tex.), chairman of the House Appropriations Subcommittee on Armed Services, said:

"The prime need is to set a spending quota for both current and future defense. We are not going to incur a danger and risk off to all directions, but we do want to incur a charge and rate."

A defense effort will be going forward in construction of a large nuclear-powered submarine offense force armed with Polaris fleet ballistic missiles.

Sen. Howard Cannon (D-Wash.) chairman of the Joint Atomic Energy-Military Applications Subcommittee, has called for prompt initiation of a program for at least 100 submarines to be constructed by 1965. The Polaris system is being operational. He recommended that the submarine force be placed directly under the command of the joint Chiefs of Staff.

Opposed Cuts

Jackson and his colleagues oppose any big cuts, and would like the submarine construction program to have a separate budget so that it would not be hampered by competing ship programs. "We feel that one can be made of defense priorities in about three percent subsistence that can fit into the present 1,900 ships from now until 1965," he said.

He said the missile-carrying submarine would present to the Society an almost insurmountable dilemma. They would have to spend billions of their resources to find an answer to fit the terrorist. It is in this area that we must now probe.

Jackson argued in Navy's present plan only that the first Polaris-equipped atomic submarine would not be ready until 1962, adding "this is the kind of lie here we can't afford."

So far in the overall defense position is concerned, Jackson said. Advocacy of cuts, overwhelming in the first order of business,

Sen. Clifford Case (R-N.J.) has urged that, "Clearly, we have to make a greater effort to maintain our national defense strength." The Senator pointed out that the defense budget will not budge the money. But

they have every right to expect that their tax dollars will be utilized with maximum effectiveness.

Today, the Senate Appropriations Subcommittee on State, Foreign Affairs (D-Conn.), Senate Majority Leader, is scheduled to begin hearings on a comprehensive investigation of the sensible and sensible fields (AW Nov. 11, p. 31).

Mobile Units

Last week

Mahon's subcommittee, which passes on defense funds held an executive briefing session with Sen. Dennis DeMille (Rep.-Calif.).

Later the subcommittee, which already has visited California missile installations and plants, planned to go to Area 5 Research Station at Edwards, Calif., and USAF's Palmdale AFB, Calif.

Other recommendations made by Jackson on the U.S. defense program include:

- Take the calculated risk of building mobile production facilities.

- Take over the responsibility for providing the best possible bombing platform for land, air and sea and under the sea.

- With a sensible defense analysis program to assure the best possible operational application of weapons.

Germans Show Interest In Northrop's N-156

Bonn-West Germany is seeking a next generation interceptor to eventually replace current aircraft. A strong contender for the contract is the N-156, a Northrop-Aviation development of the F-5 supersonic fighter.

Concerning plans for Germany, an Avro spokesman from an unnamed field test site of climb height altitude and speed performance. In addition it is said to possess capability to make it suitable in various configurations in a fighter-interceptor fighter-bomber and strike aircraft.

Several other aircraft including the Germanium 130 (the British Saab-Ra. P. 175), the English Electric E.10, the French Mirage 5A and the French Trident are also in the running.

The demand may be partially justified, since in a meeting of the committee on armaments and foreign affairs committee on armaments and the upper committee of armaments and Britain's other defense should be used to help balance each other.

In this case, there is an antitank program on Germany's part to use methods other than antiaircraft.

The N-156 would be ready for delivery in the late part of 1962. At this time present Korean war vintage aircraft are being used or added to the German air force began phasing out.

News Digest

Hawker Siddeley propellers will be used by USAF on Lockheed C-130 Hercules transports. Company will all aircraft operations and can be built in a combination between Hawker-Siddeley, Curtis-Wright and Aeroproducts. Production models of the C-130A are equipped with Aeroproduct propellers.

A V-Race, British Aircraft Ltd., Avro, Bristol, Folland, Fairey, Gloster, Huntingdon, Short Brothers and Westland and Vickers Armstrongs have completed preliminary thermal work on a British experimental aircraft. Companies are working with the Royal Aircraft Establishment at Farnborough. Large part of the main experimental work has been planned, and design and manufacture of research model has begun.

Vestal Model 205 helicopter fitted with four Lycoming T53-L-10 engines, a gas-turbine first flight has just taken place. The Vestal Model 105, classified ST-21, is increased 50% in the maximum. Vestal has been flying ST-21 with two General Electric T53 turboshafts (AW Nov. 14, p. 34).

Convair 580 Hunter fighter is set up at ground training center being given to company at Convair's Ft. Worth to about 220 USAF pilots who serve as ground force instructors. Convair embrace the basic 580 aircraft and its variants, including other series ground checkout. Personnel were drawn from Air Research and Development Command, Air Materiel Command, Strategic Air Command and Air Training Command.

Fairchild Engine and Airplane Corp. reported earnings of \$400,000 on sales of \$114,200,000 for the third quarter of the year. These earnings compare with \$173,000,000 in sales of \$877,475,000 for the first three quarters of 1958. The company has a backlog of \$177,000,000.

General Dynamics Corp.'s consolidated net sales for the first nine months of 1957 were \$1,135,182,303 compared to \$714,385,658 for the corresponding period in 1956. Net income after taxes was \$12,089,954 compared to \$23,017,406 for the same period last year.

AIR TRANSPORT

Airlines Face Traffic-Jammed Winter

Increased volume of instrument traffic saturates airways; airline performance may hit new low.

B. L. Doty

Washington—Inflaming inflame of instrument traffic, which is saturating airways, may be the anticipated consequence for Civil Aviation's Air Traffic Control system's cash program. In analysis (separately), it illustrates the service with another center of wide spread traffic bottlenecks.

A few airline officials fear that the problem of overtaxed airports and airways will become more acute during the next four months than can befit. They expect delays and flight cancellations to force airline performance to drop to a new low resulting in deeper cuts into airline gate revenues.

Altitude Plan

Last year, Capital Airlines based "an altitude plan" among members of the three major areas of its net line for the first time. This year, the situation also will have a serious effect on airline operations which have grown from 27% of total flight postings in the U.S. to fiscal 1958, to 42% by year.

The problem underscores the urgency of the CAA system plan in federal air traffic management (U.S. April 22, p. 20). Although the agency has held close to the accelerated schedule it set last fall, but spring, the progress was not kept pace with the rising traffic demand, which, in fiscal 1957, caused a 47% increase in altitude ap-

proximations over the previous year.

Airlines generally agree that the CAA project has improved its coordination, at a cost of the funds and resources that have been made available. They point to the appreciated use of IFR traffic loads at an indicated rate which capacity has been expanded to a long degree.

CAA, however, admits the system is unperfected and that operators can "lose control and more rapidly, especially in the bad traffic days."

Traffic at the three key terminals in the "golden triangle" are Washington, New York and Chicago, all of which record a sharp rise in daily changes of backlogged traffic records whenever abnormal weather creates a bottleneck or traffic flow.

Washington National Airport is presently handling 150 airline enroute

operations during a 24 hr period and approaches 200 enroute and within-terminal movements in the same period. Under VFR conditions, the average capacity is 100 enroute and 100 approach movements per hour, and between 40 and 50 movements per hour under IFR conditions.

Since the language change at Washington no route traffic control center is not equipped with enroute polarization, hand precipitation reading, radio altitude and the center is forced to revert to lone signature methods. The CAA's system program calls for a total of 75 language radios. In 1952, A total of 16 is scheduled for fiscal 1958. At present, Washington, New York, Newark and Chicago centers are equipped with language radios.

During a 24 hr period, an enroute controller handles at Washington National Airport range as high as 40 jet posts in eight sectors. At present, the maximum capacity would require 35 enroute posts alone.

In emergency, airlines can be assured of timely delivery that will backlog through an enroute system when weather conditions reduce capacity to a level lower than the IFR norm. During early 1958, an enroute controller handles up to 40 posts in eight sectors or flights mixed to Chicago.

Nevertheless, the airlines have agreed to some schedules with a view toward shifting more flights from Midway to O'Hare. The City of Chicago, which also has a large number of enroute flights, planned to study possible jettison of post separations that will permit more extensive use of dual radios. CAA will soon encounter problems in hopes of increasing the general number of likely and approachable posts in Chicago.

Out of the 21 instrument domestic and local service centers serving Chicago and 120 operating enroute posts into O'Hare, Continental Air Lines maintains Midway, Delta operates 16 flights to Midway and one flight into O'Hare. Eastern operates 21 flights from O'Hare, including six flights to New York and three flights to O'Hare, none of which operate at night.

LaGuardia Airport in New York handles approximately 160 enroute movements at a 24 hr period and about 100 enroute movements in the same hour. During VFR periods the deepest problem of Midway's ever crowded condition, No enroute controllers are in New Jersey, however, until a series

get home under IFR conditions. The New York center, which handled a total of 270 enroute posts yesterday in fiscal 1957, the highest volume handled in an enroute center with a 15 IFR language radio.

Controlled polarizations can be adopted by the enroute controller, but the lack of a route designation and radio altimeter can cut to between 25 and 50 maximum posts per hour whenever heavy precipitation occurs. The two hours can alleviate the need for language radio equipment that still serve only all types of weather conditions. The CAA's system program calls for a total of 75 language radios. In 1952, A total of 16 is scheduled for fiscal 1958. At present, Washington, New York, Newark and Chicago centers are equipped with language radios.

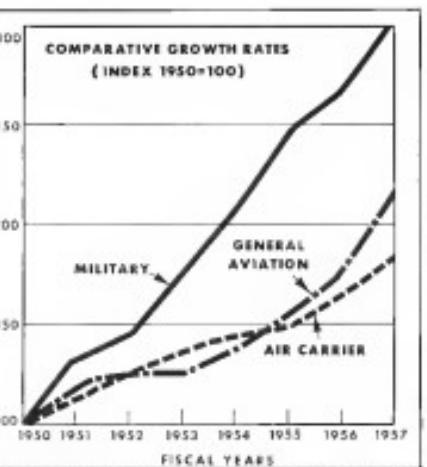
Midway vs. O'Hare

Chicago Midway Airport has studied its design post and controller plans that traffic could actually settle to a standstill with the addition of one to two additional flights. The area posts limit stems from the reluctance of enroute to make a longer detour of their operations to O'Hare field because of poor surface transportation facilities. Airlines have experienced a drop in load factors as high as 30 points on flights mixed to Chicago.

Nevertheless, the airlines have agreed to some schedules with a view toward shifting more flights from Midway to O'Hare. The City of Chicago, which also has a large number of enroute flights, planned to study possible jettison of post separations that will permit more extensive use of dual radios. CAA will soon encounter problems in hopes of increasing the general number of likely and approachable posts in Chicago.

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Low-level, Civil Aviation's Adminstrator James P. Egan, invited airline presidents to Washington to discuss the deepening problem of Midway's ever crowded condition. No enroute controllers are in New Jersey, however, until a series



MILITARY operations have grown from 22% of total flight postings in the U.S. in fiscal 1958 to 42% last year. Factors underlie success of plan for aircraft improvement

pattern that will provide frequency of flights and direct connection is established at O'Hare.

Although Chicago O'Hare's Air Traffic Control system is still in the developmental stage, and CAA doesn't expect to have the planned 360 lessons until before 1962:

• An auto traffic control center handling frequent flights for controllers at hub centers are concentrated and available for remote control after separation. CAA has cooperated with the General Services Administration to negotiate leases for new center buildings constructed to CAA specifications.

• Wind cross ranges. The Windy City project has been given top priority by the CAA and funds for installation of the units—52% surface—grant for about one-third of total facilities is granted for the 1958 year program.

• ILS. Airlines are installing satellite of their ILS units at major airports. A south unit at either LaGuardia or Washington National using aircraft from the north antenna to handle traffic to and from O'Hare. It costs \$400,000 to new equipment to handle that load. The radio telephone service will be a major contribution to expanding traffic flow control, but more facilities will be needed as operational difficulties develop.

new units of equipment in transit and tested to several before a controller is fully qualified to perform his off-duty work. Experience level of controllers is now about 40%. In fiscal 1957, CAA recruited and trained about 1,400 new personnel. An additional 500 controllers were recruited and given on-the-job training at centers and towns. Some 3,000 personnel received advanced ATC training at field facilities. Controllers, through the Air Traffic Control Board, are working to improve the professional status of their jobs in regard of securing that privilege. Thus far, they will take the exams of controllers to better position jobs and assist was success in 83 positions created by the expanding traffic.

Traffic Increase

But whatever the traffic will at Chicago Midway has been far down to date by these losses. The Midway lines handled 52,445 operations in fiscal 1957 as compared with 321,494 in fiscal 1956. The enroute traffic was lost to O'Hare with an enroute movement climbing from 24,202 in fiscal 1956 to 44,414 for 1957.

CAA's losses operation throughout the U.S. showed a 16% increase in fiscal 1958. The rate was 10% in fiscal 1957.

Against the background of peak capacity, there's the biggest antenna during the year. Last example: Delta's ranking fourth in total operations, so posted a 51% increase in aircraft operations and All-American, ranking ninth, experienced a 32% increase.

Flight postings for fiscal 1957 totalled 27,597,000, an increase of 22% over the previous year. Largest gain was reported in the Cleveland route with a 27% greater number of flights than during fiscal 1956.

Booking Cut

Tight bookings recently began their front-line, and are likely to continue. The available flights do not overall exceed last year's passenger load even though the size of the routes has declined. Large traffic hubs, Indianapolis, were generating more than 407,000 passengers annually—a record for more than 60% of all passengers and 50% of all departures.

Transports operating out of New York average 27 passengers per plane, 25 passengers per plane of Chicago and 19 passengers per plane at Washington. Average load to urban areas continues over an extended period of disrupted operations at any of the busier airports in the major cities. In addition, the growth is led because during the past year there were more improvements upon the efficient operation of each flight in order to get maximum revenue return.



Turboprop Electra Makes Early Debut



ROLLOUT of first Electra, a small short of schedule took place Nov. 11 at Burbank plant of Lockheed Aircraft Co. The turboprop aircraft went into production in May 1956. Intensive proving program is scheduled for initial low-flying with pilot of Civil Aero Teste Administration certification by next Sept. 10. A preflight of Convair IV testbed is Nov. 18 issue of Aviation Week was officially well in place of a preface of the Electra aircraft.



Major Route Awarded Trans Caribbean

Washington-Taino Caribbean Airlines, a supplemental carrier, has White House approval to conduct scheduled operations between New York and Puerto Rico. It will be the first new air passenger route to have been awarded a major long-haul passenger route to the subtropical island.

For American World Airways, now operating between New York and San Juan and Miami and San Juan, also was authorized to add Boston, Philadelphia, Baltimore and Washington as sister cities in New York Newark and San Juan route.

Other recommendations made by the Civil Aeronautics Board and approved by the President are:

- Eastern Air Lines' transport authority to operate nonstop flights between New York Newark and San Juan will be made permanent.

- Eastern's Miami to San Juan route should not be suspended but because of extremely poor flight times must be subject to constant direct or nonstop service by a majority of the major cities in the eastern section of the U.S.

- Renewal of Riddle's all-cargo route between New York Newark Miami and Puerto Rico on a nonstop basis will be reviewed when the airline's transport certificate all-cargo certificate is renewed.

- Pan American's request for authority to make cargo flights between New York and San Juan to Miami is denied.

The recommendations were made by the Board's new panel to these route earlier. In CAB Chief Economist Francis W. Black's presentation, board counsel had recommended that Capitol Airlines operate between Philadelphia Baltimore and Washington and San Juan instead of Pan American.

Two Exceptions

The Board took two exceptions to the executive's recommendation—the denial of Trans Caribbean's application, and its agreement of suspending Riddle's cargo certificate route.

The CAB and Trans Caribbean should be granted operating rights for five years instead of three to permit full development of the route. A shorter period, the Board said, would not permit a fair test of the carrier's ability to conduct the operation.

As far Riddle's request to carry mail in a non-scheduled basis over its extension of cargo route, the Board decided to defer action until after its application for domestic authority is received.

Major reason for denying Trans Caribbean for scheduled operations between New York and San Juan was the

carrier's proposal to inaugurate Tonito Skies, Inc. fare of \$45 between the two points and its implementation in the market as a supplemental route.

The Board turned down Capital and National Airlines' oppositions for the New York-Puerto Rico route on the grounds that if it doubtful that grants of the proposed low fare service would yield the additional traffic and revenue required to cover along the route where there have no identity.

The Board said it denied Riddle's application to conduct passenger operations because of the difficulty of maintaining the airline as an economic all-cargo carrier. It said United States District Attorney's application was denied and the Board that Trans Caribbean's record in the market was unacceptable.

Eastern's Service

While the CAB found a need for service between Puerto Rico and interior points in the U.S., it said it felt awarding Eastern's Miami-San Juan certificate would suffice.

By making Miami an intermediate point on three of Eastern's routes, the airline can provide single plane service between Chicago Atlanta-San Juan, Chicago-Miami-Miami-Jackson and San Juan, in addition to flights from interior points such as Chicago St. Louis and Detroit with a stop at Miami.

Delta Air Lines' application to serve the Chicago-San Juan market was denied the CAB said, because of insufficient traffic to certificate another carrier at this time.

Board Member Louis J. Heller commented that the majority decision had taken exception to one aspect. He did agree with the choice of Trans Caribbean to operate the passenger route between New York and San Juan but believed the majority was in error in suspending the majority's route certificate.

He did not feel it necessary to conclude that Riddle should receive no right to all-cargo cargo in order to defer development of the route. To do so, he said, the future of the all-cargo carrier is an important and difficult problem which requires careful continuing study. The difficulties of maintaining the corporation as an economic all-cargo carrier presents a heavy operating disadvantage to the industry.

As far Pan American's request to carry mail in a non-scheduled basis over its extension of cargo route, the Board decided to defer action until after its application for domestic authority is received.

And the selection of Delta for Chicago service was upheld.

The addition of a third carrier on the New York-San Juan route will be little, he said, to improve service in that area. "The existing carriers have increased substantially their service through the years in the traffic we caused and have added the most recent service in that route as they became available."

As for the other route, Gamma said it has been the Board's policy in several cases to expand the route structure of the smaller banks to strengthen them, to add to their self-sufficiency and thus prevent their merger in a weak status. He said the majority departed from this policy when it failed to reverse the Chicago routing route the Delta.

IATA Fare Request Deferred by CAB

Washington—Action on a proposed increase in fares between the U.S. and Hawaii and Alaska has been deferred by the Civil Aeronautics Board with a one-round circuit disrupted.

The increase was proposed by the International Air Transport Assn. and requires unanimous approval of the governments of all air carriers operating between the specified points.

The resolution adopted by IATA provided for an increase in fares between Seattle, Portland, Honolulu and Alaska from the current one-way level of \$20 to \$22.50. The increase could result in cross-booking upward adjustments by poorly balanced airlines in the U.S. and Canada. At present CAB and the head of four major fare proposals by IATA were identical with that for first class. Also proposed was a special 10-day round-trip airfare fare between Miami and Hawaii-Norfolk during the off-season period between April 15 and Dec. 15 at a level of \$36, the same as present first class fares.

The Board said it was unable to approve the proposed fare increases because no objection had been made to the serial. No information is supplied after the proposed flat-class fare in effect in the interisland level was removed from the carriers' CAB bid.

At the same time, the Board said proposed changes with major in pricing IATA agreements appear necessary in the public interest. In view of it is tended to implement the change at the time the Board acts on the basis of the resolution adopted at the IATA traffic conference in Miami recently.



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American Testimony Opens Fare Probe

By Fred Eastman

Washington—Tensions in the Civil Aeronautics Board between the de facto CAB first ordered in May, 1946, opened before the Civil Aeronautics Board Review Panel Ralph L. Wiser last week with American Airlines the first of 12 domestic airfares to take the stand.

American President C. R. Smith headed a long list of carriers scheduled to present arguments designed to restrain the CAB first passenger fare should be increased. South and Trans-Canada, with a rate of return via invested capital, after taxes, of about 12%, and that if it turns that fares should be increased by 15%.

He and the railroads were joined by seven other Senate consultants and American's own studies and experience.

American is one of the nation's strongest domestic carriers financially, and its rate of return in the past has exceeded the 12% figure at current fare levels.

Last year its rate of return was 11.5% as revenue and dollar return reached an all-time high.

Shrinking Profits

Smith and Jameson, their law firm also marked the beginning of a downward trend in profits which is due largely to overhead costs from raising the capital in the industry. Instead, he said they look to other enterprises with more stable earnings in which to invest their money.

Smith noted that American already has ordered 10 Boeing 707 jet transports and 35 Lockheed Electra turboprop transports in an overall plan to expand its fleet by 100 aircraft by 1965. The cost of the new aircraft program totals \$900 million. The cost of the 707 is \$10 million each, and the cost of the Electra is \$1.5 million each. The cost of the 35 Electras will be approximately \$50 million.

At the time the loans were negotiated in 1951 and 1956, American had a lot of cash in storage. It now has after fixed charges and taxes will be less than the \$185.528 million mark.

To complete its further equipment program, Smith said American would require 15 long-haul and 25 medium-range aircraft. In addition to those, it will need 100 short-haul aircraft, consisting of 3200 airline stations, the cost of which is given as \$100 million.

"We do not have that money,"

Smith said. "Our total net worth at the end of 1946 was only \$325 million, and it will be very little more at the end of 1957. At present fare levels we will suffer a loss in 1955 after payment of interest."

One can fly through 1965—again at present fare levels, and even with one diagram or additional equipment orders—would bring us to potential losses. By the end of 1956, current legislation will severely curtail income as such resulting in negligible working capital position.

South said the only way American can attract the maximum capital is to complete its program through a reversal of the downward trend and an increase in strength to a point where airfares can compete with other businesses for a share of available means.

Attracting Financing

Edwin H. Elzinga, a partner of Lawton Fries & Co., investment banking firm and a director of American Airlines, followed South to the stand. He said the company required annual earnings of about \$75 million in order to attract the necessary financing.

This would not only prevent the company from unduly adding to its debts but would place American in a stronger position to raise equity capital as well.

Elzinga explained that on the basis of present earnings and forecasts of earnings, the new American could raise

in the way of additional capital over and above present commitments would be about \$25 million. He said leaders will be used reluctantly to convert them selves on a set project when they see that present circumstances already are considerably less than they were a short time ago.

To support both the present program and to have any hope for future financing of the additional program, Elzinga said, "there must be a rationale not only of the aggregate dollar earnings to the level of a year ago but also a restoration of the atmosphere existing in 1947-1956 period."

Alpine Stocks

Another witness appearing on American behalf was Benjamin S. Cleiburg, general partner of White, Weld & Co., investment firm.

Cleiburg's testimony was devoted to an explanation of why airline stocks are not considered attractive for investment purposes in relation to other investment opportunities.

"The broad aspects of the problem are quite clear," Cleiburg said. "Rising rates are reflecting as a result of a strong growth in spending and the desire to take a place on the very top of economic expansion. This is an effort of all this has been to distract the confidence of professional investors in the industry's future. This is shown largely in the drop in price of airline stocks."

The hearing is expected to go well into next year and has been divided into three phases.

The first year under way concerns the rate of return for airfares, the second will cover the forecast of future operations while the third take up remaining issues.

Cargo Line Asks Route to Moscow

Washington—Scandinavian and Western Airlines last week applied to the Civil Aeronautics Board for permission to extend its transatlantic flights north to Berlin, Warsaw and Moscow.

The present terminal points of the airline are Hawking, Marsh and Zurich.

At present Pan American World Air ways holds a U.S. permit to operate into the Soviet Union. A suggestion earlier this month by the Soviet air force that it take the route between the U.S. and the Soviet Union is based on a possible bilateral agreement between the two countries, has not materialized (AW Nov. 11, p. 48).

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SHORTLINES

► Allegheny Airlines has acquired Civil Aeronautics Board approval of a schedule that will trim the time of 100 flights. The fare, scheduled to become effective on Dec. 1, would permit passengers to fly at 75% of Allegheny's present first-class fares.

► American, Colombia National Airways, will begin operating 11 flights a week from the U.S. to Colombia on Dec. 1. Nine of the flights will originate at New York International Airport, two at Miami International Airport.

► Iberia Air Lines of Spain, General Director, Count Carlos Lasa, says Iberia's international airline service to Africa, the Americas and countries of the Andes South American services include Santiago, Chile and Lima, Peru.

► Newark Airport will be serviced by a new \$8 million air cargo center. The Port of Newark Authority has announced. The center, comprising four large three-story structures on a 24-acre site, will be operating by the winter of 1959.

► Pan American World Airways reports a 17.7% increase in enplaned Atlantic cargo service during the first nine months of the year over that of the same period of 1958. The airline claims to be carrying 23% of the transatlantic air cargo total.

► Southern Airlines flew 10,160 passengers during October. The airline, which currently handles an one-million passenger capacity, reported a 10-month total of 151,400 passengers flown. 31,300,000 passenger miles.

► Swissair is offering a 12-day ski tour to the Austrian Alps for \$395.00 each winter. The airline also plans a number of similar tours for January, February and March, including 21-day routes in addition to the 12-day excursions to St. Moritz, Austria and French mountain resorts.

► Trans World Airlines will begin nonstop Lockheed L-1049 Constellation service from New York to Frankfurt on Dec. 5 with six flights weekly. On Jan. 1, TWA will begin nonstop flights to Zürich from New York on Dec. 8, Sunday, and will serve New York and Madrid. This will bring to eight the number of European cities served by flying TWA flights.

AIRLINE OBSERVER

► American is beginning to fill the patch of defense cutbacks (AWW Sept. 30, p. 47). Decline in travel by noncommercial has caused West Coast traffic to drop and has been particularly noticeable in Western Air Lines operations between Los Angeles and Seattle. Boeing, with headquarters in Seattle, has advised its people to use coach flights rather than first-class when possible. W-receipted expansion of such a route in the defense markets could not wait so long as deeper cuts were imminent.

► American Airlines is converting 10 of its standard flat-class DC-7s into comfortable configurations and expects to complete the modification by the first of the year. More is designed to increase flexibility in scheduling aircraft and to expand flight frequency of both tourist and first-class service.

► Work on an intensified sales campaign by Douglas Aircraft for its DC-8 medium range transport is progressing. Douglas wants a non-airline client for production of its Santa Monica plant more recognizable as the DC-6 and DC-7 series will be completed in three months, and the end of the production line will soon be at sight. No bidding on the Santa Monica project is large enough to hold the larger DC-8 long range transport import.

► Pan American World Airlines has been forced to delay inaugurating of service to new routes from Puerto Rico to Madrid because the Spanish government continues to stall in giving the new services its approval. During talks with the U.S. State Department in October, the Spanish government asked for five days to study the proposed Madrid stop before granting Pan American its permission to operate the route. Many observers are beginning to feel that the state wants to force a few of the new routes competition for state-owned Iberia Air Lines of Spain and may postpone the route indefinitely.

► United Air Lines will be operating an all-jet fleet by 1965. The plan encompasses the purchase of 92 jet-powered turboprop aircraft in addition to 30 DC-8s as yet un-ordered. The carrier has definitely discarded older planes to include long-range transports as its program. That will consist of 30% long-range equipment, 40% intermediate range and 30% short-range aircraft. First stage of a \$12 million expansion program at the airline's San Francisco base will begin shortly with the construction of a jet cargo terminal building with a 50,000 cu. ft. expansion of general facilities at a cost of \$4 million.

► British government has rejected claim that some sort of vibration of a Bristol Br-109 turboprop transatlantic aircraft occurred during flight from London Airport on Sept. 26. Bradstock claimed the aircraft, on a diplomatic mission, caused distorted windows and cracked tiles and broken plates during a flight that started at 9:01 "without notice and disturbance." The government reported that an independent investigation showed there "was no sign of long standing and attributable to causes other than takeoff."

► Trans World Airlines pilots are accompanying the airline's sales representatives to calling on Kansas City businessmen in a voluntary Sales Program of the experimental plan to help augment business travel with the technical aspects of airline operations.

► Pan American Ethical Products will begin public hearings Monday on Dec. 16 for a second Washington airport. Qwestair has narrowed the selection to four possible locations—Bellevue, Clarendon and Freeland, near Virginia and Baltimore Thruway Airport.

► Pan Am, Air Lines has leased three DC-7s from United Air Lines and its Los Angeles division from Trans World Airlines until May, 1959, to handle Florida's winter traffic. Eastern will operate the DC-7s in first-class service and the Constitution in 70-passenger service.

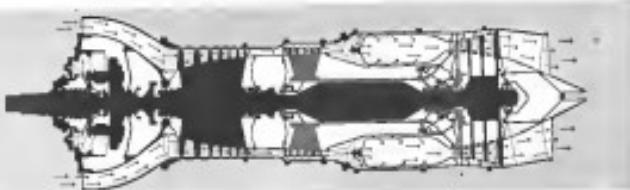
► Capital Airlines and Shell Oil Co. have entered their turbine fuel contract for a four-year period. Estimated consumption of the 640 kilometers will run approximately 80 million gallons annually.



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Facts on the mighty new Orion

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Bristol's two compressors. Work split between low and high pressure stage is arranged to allow both wings to run near maximum adiabatic efficiency. The two-spool layout also leads to unprecedented flexibility of operation.

Advantages of "Gaging." Orion is an 8,000 horsepower engine differently. Thrust at sea level goes down at 10,000 feet and maximum rotating power is down 3,000 rpm. By retarding engine to 5,000 hp from sea level up to 10,000 ft., propeller and reduction gear can be lightened—giving reduced resistance at specific weight.

To the rate of rise at high temperatures or elevations, the thrust can be given its head by simply opening the fluid-injection water injection and other power boosters are unnecessary.

Planned economy. Specific fuel consumption of the Orion is well under 0.07 lb/hp-hr. This performance means that it is possible to achieve long-range, low cost transport of high payloads.

Orion powerplants could operate at 200 engine-days playing parity, twice energetic with pure jet-fuel at a fraction of the cost.

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At the same time, the CAA will take advantage of another dimension in the station of flight reproduction — Curtiss-Wright Delmal Visual Aids Simulation Equipment. This new Curtiss-Wright equipment consists of scale models of specific airports, and a mobile television camera which responds to the pilot's control — enabling him to rehearse landings and take-offs under VFR (Visual Flight Rules) conditions.

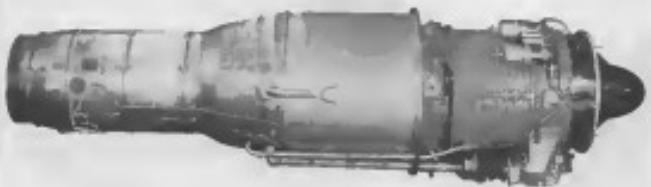
The airport environment, buildings and runways are realistically viewed by the pilot, on a large screen, in their true relationship to his altitude, position and approach.

Simulators by Curtiss-Wright have been produced for nearly every type of advanced civil and military aircraft. They have a long background of proven service, including extensive use by the CAA itself. Every fully electronic Simulator used by U. S. airlines today is a product of Curtiss-Wright.

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ORPHEUS 3 (inlet) for NATO light fighters is less than 8 ft. dia., slightly more than 6 ft. long. Thrust weight ratio of the engine is 1.9. Engine has seven compressor stages, a variable compression chamber, and a single-stage turbine. Dry weight of the engine is 525 lb.

Light Orpheus Jet to Power 11 Designs

By David A. Anderson

Bristol, England—Once again aircraft system contractors are being held around the Teledyne lightweight turbojet developed for the NATO light fighter program.

Under a contract with the joint Milt. Nat'l. Weapons Development Program of the NATO countries, Bristol is developing and building the Orpheus 3 and its successor, the Orpheus 12.

Orpheus 3 powers the Breguet T.10, Dassault Etendard 6 and the Flettner G.91 through the company's own test beds at Breguet test facility (AVN Oct. 28 p. 52).

The earlier Orpheus 1 engine, of the French Chtz. de l'Aéronautique laboratory, is little like the earlier Orpheus 3, scheduled to go in Grumman's F-104G T.3F. It has been designed around the Bristol engine. Spain's Hispano HA.300 delta-winged interceptor and Yugoslavia's project incorporate the Orpheus.

In the United States, North American Aviation has specified the engine in an ultimate replacement for the TA-26 transport and its T-27 trainer for the Navy.

Built Under License

He engines will be built in India under license. The Plessey firm of Stowes has license to Orpheus development. Plessey is likely to option on a license and Curtiss-Wright in the United States has a license to build the engine as the T37. All five started with engineering pro-

tection at Bristol. First there was the protection of the need; it didn't exist at the time, but some Bristol people thought it would. Second, there was protection of the way to avoid the need to design a rugged light-weight engine that could be suitable for a family of light fighters.

Bristol's detail design work and the first running of the engine are separated in time by less than a year, which will be some sort of a record for a contemporary jet engine.

Box 5000 of the current engine

Engine Description

The Orpheus series of engines is built around a two-spool axial flow gas generator, a variable compression chamber having seven individual flame tubes, and a single stage turbine. It may also be used as the number of parts is increased to 1,000. External engine discussions of the engine show a can-



CONTROL and economy portage of Orpheus 3 is located on surfaces of engine at forward end of compressor casing, far away from field. Simple maintenance was a design criterion.

THE IMPACT STORY BEHIND THE PICTURES

This man is making aircraft control cables for the F-104 Starfighter. He is using the latest computerized impact equipment.

WORKING—Peter M. Schaeffer made this work on his Orpheus 12. The engine is a 12-cylinder, air-cooled, supercharged, horizontally opposed aircraft engine. The newest Cecostamp impact blow forms are used here to impact sheet metal. Note how the impact tool is held firmly in place by the blow form.

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Blow Job is a picture Cecostamp (continued)



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Orpheus Engine Specifications

Engine	Orpheus 2	Orpheus 3	Orpheus 4	Orpheus 5
Bore diameter, in.	4,300	4,400	6,300	8,300
Stroke, in.	22.6	22.4	22.4	22.6
Length, inches from front to exhaust				
Design, in.	72.9	75.45	75.45	80.47
Weight, dry, lb.	266	323	388	1,024
Thrust weight	3.7	3.9	6.8	6.1

gross width of 32.4 in., a maximum height of 46.1 in., and a maximum length of 75.45 in. The engine is 32.4 in. in length from the front of the intake to the flange of the exhaust nozzle at 75.45 in.

The outside diameter of the main engine is constant. The air discharged from the last stage passes through a duct that splits into the diffuser, carrying the air from the fan section between the compressor and the combustion chamber housing.

Each of the seven internal thrust tubes ends in the central combustion chamber made in a transition to a series of stages ending with the exit end.

The single-stage turbine is an centrifugal layout, as can be seen immediately in the high altitude versions of the Orpheus.

Intake is in a variable system with a variable inlet and half parts of all throat cut during a typical flight. There are, two boosters, a solid bearing behind the compressor and a double row ball bearing ahead of the solid guide vanes.

Accessory Power Drive

Recirculation gas off the main compressor drives a vertical propeller in the intake, and control perhaps under the engine.

All blades are precision forged to use the slot resulting in close in the blade root.

Compressor blades, discs and stators are made of light alloy. The intake cone and the compressor casing are made of aluminum magnesium alloy and the delivery casing is aluminum.

In the hot section, the base tubes are made of Ni-Mo-Ni "5" and the top base tubes are Ni-Mo-Ni "9". The tail base disc is H-166 ferritic stainless steel and the blades are Ni-Mo-Ni "9". External core and jet pipe are made of Ni-Mo-Ni "5".

The increased performance expected in the Orpheus 12 development will undoubtedly call for more changed material specifications.

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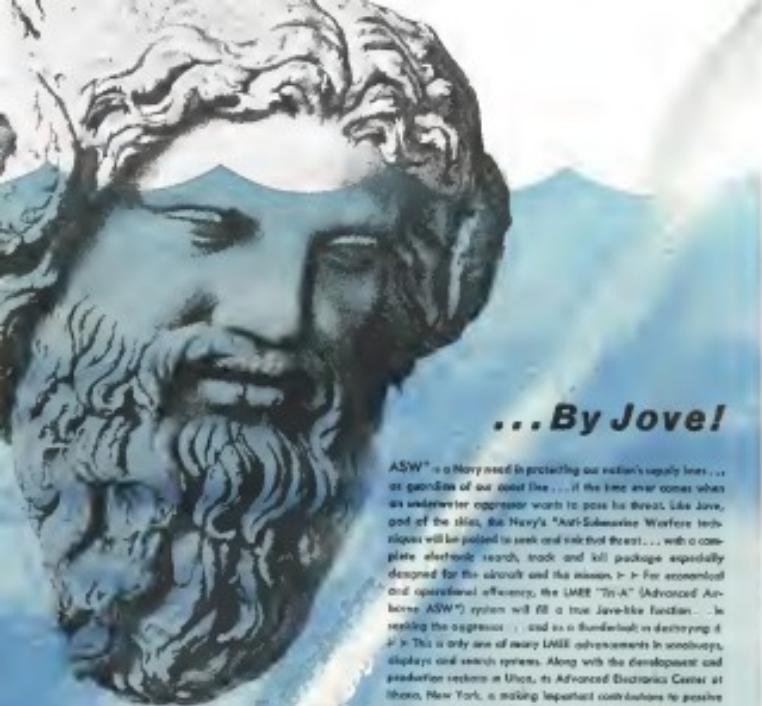
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USAF Cancels J91

Washington Air Force has officially announced cancellation of its contract for development of Pratt & Whitney's 20,000 lb thrust J91 turbofan engine, which was scheduled to power an aircraft plane.

Plans for cancellation or cancellation of the project had been known for some time and in August Pratt & Whitney announced its needlessness that the program might be "possibly discontinued entirely" (AW, Aug. 19, p. 34).

The reason is that its contracts with General Dynamics for a second jet-powered rail car with Convair and Lockheed for engines for the stratospheric project were still in R&D.

Ripped off the engine, and the basic cause was that the engine was operating too slow, in the range 1000 rpm that caused cracked ribs in the engine by resonance in effect producing hotbed conditions with the engine. The 1000 rpm dropped but the fuel flow continued to a high power condition bringing with the result the engine blew out.

The cause was a simple one. A switch in the gas flow during certain reduced fuel flow put a split-second before the gas was fired, with reduced fuel, the engine power never developed normally and the range between it and the surge line increased. Resonance stopped. Now the Gandy's gear can be fired right up to 45,000 R.

Odysseus 2 Controls

Use of the Gandy in an entrepreneurial project a pair of additional controls made Odysseus 2. An altitude acquisition unit is now being switched on the project, and also a pressure range control which keeps the operation automatically below the range line in a condition of flight stability. Acceleration from flight idle to maximum power at altitude using the ratio control is expected to be about four seconds.

NATO's engine is the Orpheus 3, being developed under a contract to cover powerplants of 60 engines. Orpheus will be similar to the Gandy. Its design is firm but the contract has not yet been let to cover the developing work of the engine, in the Orpheus 72 including its type test.

Although the specification for the light fighter calls for four sec in a ground-support role at various altitudes below 10,000 ft, the recent test of British aircraft conducted under the suggestion that successful engine operation would have to be shown at 30,000 ft.

The engine is also required to oper-

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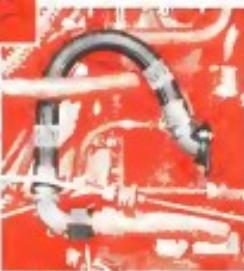
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plus 100 lb. thrust is attained at a static value of 5,370 lb. total load.

The engine will undoubtedly have to be the ultimate engine for the NVAO light fighter program if that program reaches tangible fruition. This engine is that sort of the current engine designed to the specifications and needs of the Israeli companies. Now, there is one more part.

In one report, the Dassault Ouranor has been redesigned for the Orpheus 12 engine. The increased air flow seems to increase the engine's specific output. The revised design means that more fuel must be provided to match the NVAO power plant. Luckily, Dassault found the extra fuel could be obtained within the increased dimensions of the fuselage made necessary by the installation of the Or 12.

The reported Orpheus 12 length and mass has lost its possible configuration changes within the engine. For example the compressor stage might be as small as possible so that a thicker stage might be added. Bentoflex won't say what the engine is going to look like, but it will be very compact. But other sources indicate that the engine should be running by June 1958, judging by Bentoflex's short developmental time for the Orpheus units that schedule looks entirely possible.

Orpheus History

Development of the Orpheus line is rather checkered. It was not designed for the NVAO light fighter program but rather developed to meet the requirements of the program.

The Orpheus originated as an experimental engine for a pair of experimental long range transports being developed by Bristol and Vickers. The first two prototypes had done in 1951 a flight for a duration of 3,000 hr. selected static thrust weighing no more than 100 lb. and with no assistance. The thrust weight ratio was six-to-one which is a tough design goal to those days.

Bristol began work on an engine designated the BE 17. It has run on into the world conflict between supplier, user, and manufacturer. The expandable feature of the engine which the British are particular about were not compatible with the required thrust weight ratio and the program ended. Ideally the engine would be an all-welded structure, for protection against heat endurance, it would have to be welded in machining tolerances in order to produce the thrust.

Bristol decided on a more orthodox second approach in the war but decided to return to some features of the expandable engine design as possible. This proposal became the Bristol BE 22 before and a 1,750 lb. thrust and was the original engine W.F.W. R.1000 mark

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as the preplant for the Folland Gnat light fighter.

But the experiment for the expandable boosters was canceled and right after that so was the British engine, for lack of funds.

Bristol engineer under Dr. Stanley G. Hooker somewhat commented that such an engine was going to be needed and took another look at the whole question of private, lightweight, high-thrust engines. He said they had been exposed to the design thinking of Peter and had left the power equation behind the light-weight fighter concept.

So Bristol made the decision to develop a lightweight engine to keep Britain's aircraft in the flying fleet that were both in going to need one fast soon. This caught up with the existing options and all, because it probably was the future availability of the Orpheus engine more than any other factor that determined the final requirements for the NATO light fighters.

Detail design studies for the Orpheus began in January 1957, and started from one of Hooker's suggestions. He proposed taking the low-pressure compressor from the Gnome supercharged transversely opposed twin under development Bristol and building a lightweight engine around it. That became the design proposal for the BE.26 Orpheus as it happened, the Orpheus went an operating engine before the Delta.

Development Schedule

Detail design started at the beginning of 1958, but the first manufacturing drawings were issued in the spring of 1959. Rig testing of the compressor, turbines and other components began in the fall of that year. The first Orpheus prototype engine was started and ran up on the test stand Dec. 17, 1959, less than one year after the start of detail design.

This engine, like previous engine prototypes, was destroyed during its early development life. In May 1960 it had completed a 150-hr type test at 2,215 lb thrust and was cleared for flight.

The first flight was made in the prototype Folland Gnat July 10, 1955. Type test followed type test. The Orpheus B. Or. 1 passed at 4,070 lb thrust flight in January 1961. In November that same the second development of the base engine, the B. Or. 3, ran through an 150-hr runout at 4,520 lb and reached 4,630 lb in 5,930 during the test.

The Orpheus 3, intended for the NATO fighters, was type tested in May 1957 at 4,570 lb, the guaranteed thrust for the engines of the light fighter program.

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use of Ophir is about 8,000 hours with about 500 of these flight time and the rest instrument hours. Current emphasis being with the Ophir includes the three NATO fighters—Beggar Tang, Dassault Standard 6 and Fiat G-91—Squadron Leader Lockheed Jetstar and Avro Andover test aircraft. Northrop Ophir will be the first aircraft to be used as a flying test bed. The plane should fly before the end of this year.

Now the huge demand on which Ophir and later more version B come from the final evaluation of the NATO light fighter competition. It is almost a certainty that no Ophir 3 aircraft, beyond the original 60 of the Mutual Weapons Development Program, will be ordered. The lead engine for the light fighter project will be the Ophir 12. But the number depends on the number of fighters ordered and that will still be determined.

The Ophir 3 is the aircraft which the NATO fighters which the Ophir 3 will immediately shift to the Oc 12 when it becomes available.

May Four Bombs

Should the NATO order be placed, Ophir would be flooded with work on literally thousands of engines. There is the possibility that the Ophir would be produced in greater quantity than any other turbojet except possibly the General Electric J47 and the Pratt & Whitney Avon series.

There is also the possibility that the engine could do quite well with the death of the NATO program. The market for good alternate orders may be few at present and would decrease if Mutual Weapons Development Program funds were cut off.

Ophir is in good shape to begin the engine production that could come its way, although a tremendous amount of NATO engines would probably be prime and technical reasons, be split among Bristol Siddeley and Fiat.

With everything in sight, Bristol's engineering gamble of 1957 is paying the pay-off.

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Honeywell's vast experience in flight control systems, navigation and regime controls makes us the logical company, not only to do that advanced work, but also to aid you in your subscale control problems. Control, Minneapolis-Honeywell, Aerospace Division, 2600 Ridgway Road, Minneapolis 15, Minnesota.



With a plane such as the small 250,000 ft. I.A. that must be controlled, reaction controls which overtake energy gain from small system modes are required at very low and zero G-loadings by generating angular accelerations in roll, pitch and yaw. Development of the necessary control system for this type of aircraft control is now in progress at Honeywell.

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F-105 INLET (left) engine intakes cut back to angle to reduce air which builds up behind the shockwave as it moves back into the inlet to spill over the top and bottom of the inlet. Moveable plug (right) holds the normal shock, max at inlets, at best position.

F-105 Engine Inlets Efficient, Reliable

By Robert Cushman

New York—Inlets for Republic Airplane's F-105 show recent trend toward internal-type intakes for aircraft above Mach 1.6.

The F-105 inlet is one of the first examples of a new configuration developed by Dr. Antonio Ferrai, now head of Brooks Polytechnic Institute's Department of Aeronautical Engineering and Applied Mechanics, when he was an assistant professor at Cornell University, Ithaca, New York.

Front Oblique Shock

At first, before the F-105 inlet design, the same oblique shock pattern at flight speed was not an external shock wave with the main intake leading the point of entry of an external type. While it is preferable not to feel such shock above Mach 2, in the F-105, it was the type of inlet chosen by Republic for its advanced F-105 because that aircraft was expected to reach Mach 1.6 before it became necessary to have such

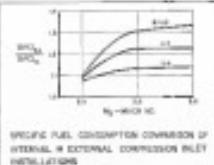
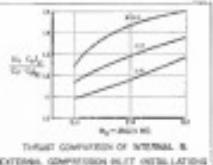
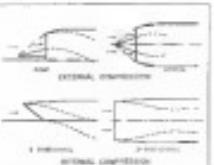
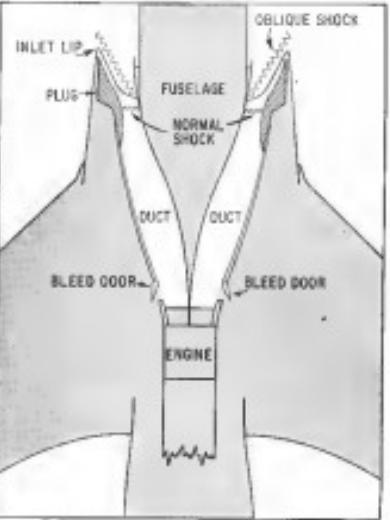
planned for Mach 3 flight (AV Sept. 9, p. 101).

Comparing the F-105 intake with the F-104 inlet, it can be seen that the F-105 intakes are not only side or shock mounted rather than front mounted, but they also are intake in place view.

The first shock starts from the end side instead of curving from a sharp diagonal to the leading edge, as it does in the Lockheed F-104 inlet.

A pure external system would achieve a shock from a single normal shock inside the inlet. Davis, Drift and Thomas, in a paper of Lockheed Aircraft Corp., state that in an inlet before the intake, an asymmetric shock wave will cross through an all normal inlet system would be inferior especially at Mach numbers over 2, apparently no designer has, however, a practical means for starting such a system.

For explosive reasons the type of supersonic inlet as in F-105, 2.7403 percent greater lift than in F-104.



CURVES (left) Lockheed engineers show an theoretical basis that external intake, because of lower cost drag, are 20-30% better than external intake in the Mach 2.0 region. Thrust to drag ratios for two types are plotted against Mach number. Additional variable K represents ratio of cooling air for usual transonic inlet to that of two-dimensional inlet; those same inlet types are superior to others.

For maximum pressure recovery the inlet must be able to provide a smooth transition downstream of the leading edge. When increasing rapidly at transonic flight speeds, the inlet flow upstream of the inlet throat is super sonic, while downstream of the inlet throat the flow is subsonic. In this condition the inlet is to be stabilized.

However, the problem is to get the inlet started. For the inlet to start after some flight speed is exceeded, the first shock must, a strong shock wave which divides the supersonic flow from the subsonic mass move from the inlet entrance (where a still of course faces the aircraft coming up past Mach 1) down the inlet to the throat section.

The rate of air flow will then increase as the inlet will be able to receive the air entering it during starting, part of the air downstream of the normal shock wave must spill outside the inlet if it moves back.

Inlet Flow

From pointed out that because a wide, low inlet would have the greatest spill area, it would be the easiest to start. In the case of the F-105 it can be seen that there can spill over the top and bottom of the wide intake while the first shock is moving back.

After the first shock has moved forward the last oblique shock caused by the forward edge of the forward pressure wave will form.

In the particular F-105 inlet referred to, from the nose and the intake with wide intakes such as are indicated to the leading edge of the wing root on the F-105, is that the trailing edge is high. In his patent he therefore proposes that a series of three outward pivoting edges be in a staggered side by side that they rotate their starting positions but prevent lower drag configuration for the aircraft. The set arms in effect would be divided into a series of smaller pivoting shapes which are staggered to spill their own flow into each other, cascade fashion.

Once the F-105 inlet solves it is stated a further refinement is possible when a transonic disturbance of the leading edge. When increasing rapidly at transonic flight speeds, the inlet flow upstream of the inlet throat is super sonic, while downstream of the inlet throat the flow is subsonic. In this condition the inlet is to be stabilized.

Overexpansion of the engine will lead to flow sheet, meaning as the plug is moved to a wrong position.

Large sudden drag load on aircraft with attendant loss of engine thrust upset of flying supersonic and plug goes to subsonic.

Difficulty of leading surface of plug ends in incomplete portion. Complete loss of performance potential of aircraft if plug sticks in subsonic portion.

Reliable Controls

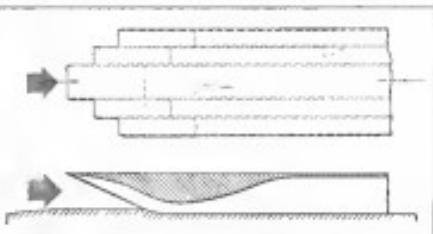
Luc Inc's Grand Rapids, Mich. Division which makes the control and actuation devices for the F-105 thrust reversal plug as well as preflight an optional variable nozzle.

Unlike the B-57 inlet control system, the F-105 system controls the variable inlet geometry as a pure mass equal loop system allowing the inlet to be controlled directly from the aircraft's flight Mach number. The B-57 used a hybrid closed-loop control system, the F-105 system controls the variable inlet off signal from pressure servo system piston extending from the inlet lips into the external shock waves. Low loss & low residual pressure piston of the difficulty of obtaining stability at higher Mach numbers.

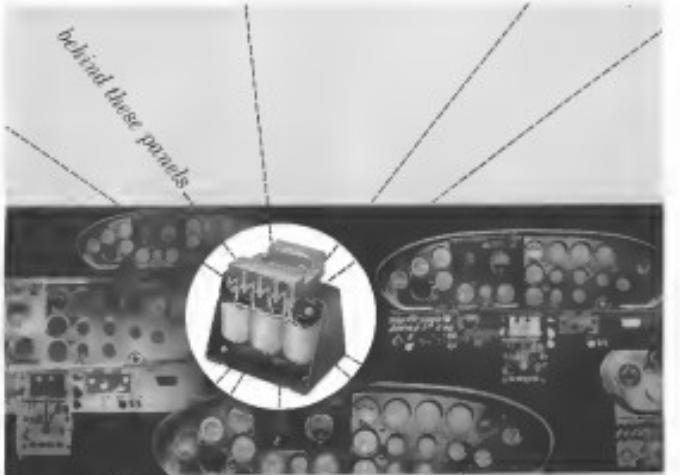
Last engineer, William Stribley told

Stribley said that the aerodynamicists indicated it would be a simple task when the controls made available what would be required for optimum stability. He later stated, and Stribley is designed to absorb jet which is one selected position.

Low drooped inlet is promising inlet controls for the Convair F-106. The F-106 inlet appears more compact and uses an adjustable internal restriction on the leading side of the inlet area.



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IAS Stresses Defense Management Skill

By Craig Lewis

Dallas—Management skills, it distinct form—and essential to engineering skills in the functioning of the weapon system, were highlighted in a major area of concern during the Oct. 10 Midwest Seminar Series of the Institute of Aerospace Sciences.

Moving to an atmosphere of rational confidence in our strength demonstrated through technological advances, delegates were told by Lt. Col. S. E. Anderson, manager of An Research and Development Command, that a high rate of management skill will be vital in the U.S. effort to meet the Soviet challenge.

Need for Knowledge

The ARDC commander also advised that the aircraft industry cannot afford the luxury of gaining knowledge and experience in weapons systems "the hard way." He said, "You can't make use of every facility at your command to further the exchange of technical information," he said.

Fordham's recognition of the demand for a high type of management skill came from Gen. David R. Cook, USAF (ret.) president of the Aircraft Industries Assn. He pointed out that on the policy level management competence has a greater importance than engineering or scientific talent. "Whether we like it or not, technical competence and management competence are not synonymous," Cook said.

Observing that the real weapon system is the man in the field, the military service conception, in the future the concept of war is to be by contract. Cook cited the need for close relationship between military managers and the industrial managers to whom they delegate a portion of their responsibilities.

Taking the lead in weapon system management, William F. Balfour vice president and general manager of Nortronics Division, Nortronics Aircraft, Inc., observed that the concept has developed to a level "that it is here to stay."

On one level, the Air Force has developed a system which requires systems management effort from acquisition through the ARDC and Air Materiel Command phases under joint ARDC-AMC management. While this approach is a step in the right direction, Balfour said, the USAF management expertise is hampered by the policy of rotating officers in three-year cycles.

In view of the time it takes to develop a weapon system plus its service life of anywhere from three to seven years, Balfour observed that it is poor

to have as many as five complete management changes in the Air Force as an long range program.

Balfour pointed out that USAF has adopted two approaches in combat positions of ensuring weapon equipment and the ever changing management posture of the Air Force. First approach involves use of a contractor for long range management of initial weapon systems under guidance of a weapons system project director, said Balfour. In complex nations an early establishment of a special organization such as Westcom Development Division to handle some of the more complex weapon systems.

Other lead of weapon system management development has been in areas where managers have not only had to cope with more complex systems, but have also had to expand into the operational, maintenance and economic phases of these systems.

Balfour said that in spite of increasing system complexity continuous effort must go toward simplifying the management job. If the management job is simplified, "complex systems will be much closer to the people who are associated with decisions of the weapon system program."

Most Important Factor

"We will be able to see in addition to all these technical problems, the underlying defense which has become most important to all weapon systems today," Balfour said. "That factor is protection."

Management of the Army guided missile program was discussed by Dr.

Martin Schilling, chief, program management staff, Research and Development Division, Redstone Arsenal. Reviewing the Army management approach Schilling said that of over development dollars received in Redstone, Annual 30 cents goes into the efforts of research activities.

Requirements of integrated programs involve delivery of needed weapon systems to combat units in time to meet the needs of the field," he said. He added that systems management will be required to guide weapons within a government contract system and as well as those groups where the development and subsequent production are actually performed."

Schelling's Innovations

Discussing scheduling problems, Schilling observed that some automated systems that can assist schedule invention.

"The simple truth," Schilling said, "is that you must schedule and there has to be great incentive to an acceptable outcome in order to solve scheduling problems. The key to the whole problem is the motivation of a supervisor to think, but it is an art, too."

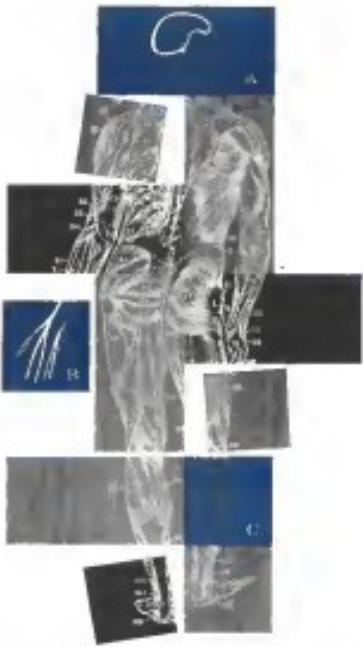
Turning to ground crew budgeting problems, Schilling observed that generally the size of "overhead" a service program with reflected overhead funding is often proposed in actually carried out.

With a single missile system, Schilling said, good management, streamlined administrative procedures, and much end-to-end funding can produce outstanding results, and outstanding



FJ-4B Markings

North American FJ-4B operating with Fleet Air Reserve Unit, Veterans NAS. Dark lenses on first markings on tail, wings, and nose. Aircraft is an FJ-4 Fury fighter modified for low altitude attack operations. The FJ-4 is powered by a Curtis-Wright J67 turbojet engine developing 7,800 lb thrust (AW Jan. 1, p. 28). Note stacked vertical stabilizers.



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Job, to take off the carbon in controlling aircraft by hand. Maintenance should also provide staff assistance.

The engineer who endorses this gives a specification as necessary, who along with his supervisor, sees his radio equipment fail under environmental test conditions, after it has left his hands, will be best to correct the failure," Lohse said. "But the engineer who does not understand the reason for the specification, who is provided no opposition, for the elimination of troubles, and who learns, perhaps months later, that someone has alleged that his equipment was the cause of a missile flight failure, is quick to say the testing he performed is the initial design of the equipment."

Need for Research

When the program manager has things under control and has forced the customer his organization can build reliable equipment quickly, he spends some time on adverse tracking, Lohse pointed out. Thus the manager can encourage the need for research in making the equipment lighter and cheaper and he can see there is some sophisticated work to be done in shock mounts and packaging concepts. And he has the background to set this program in the given context because he also sees that effective measurement criteria is an essential part of any practical reliability program, Lohse said.

Purchasing programs for the high performance B-58 weapon system was described by Robert Kuhn, manager Material Department, Convair, Ft Worth Division. He pointed out that the performance specifications of the B-58 exceed new problems for the vendors involved in developing subsystems for the new bomber. Since the super sonic B-58 weapon system required some very unusual features, new requirements, subsystems, Kuhn explained that it was important for Convair to choose competitive, reliable vendors for these subsystems. Vendor was chosen through an elaborate program that involved visits to vendors in Convair, Ft. Worth and visits to Convair evaluation teams to vendor plants.

Kuhn said that one of the problems Convair faced was convincing vendors that the company did not intend to sweep vendor fields in producing the B-58 under the single manager concept. He pointed out that 47 cents out of every dollar of the B-58 program goes to vendor teams.

Integrated design can produce more efficient cooling systems for aircraft and electronic equipment in high performance aircraft, according to P. E. Petty, president, Englebar, Chance Vought Vought.

Petty told AIAE delegates that new and different cooling systems of high

performance circuit can be integrated into a single efficient system if cooling characteristics of the core and skin thermal equipment are designed to be comparable and are switched to the aircraft performance envelope and if the system is installed so that it can take advantage of every available time before changing the cooling mechanism overheat.

Cooling Answer

In developing an integrated cooling installation for both the core and electronic gear, the cooling system designer can often share the weapon system manager's advantages and disadvantages of operating time and effort in designing or redesigning electrical components to improve their cooling characteristics, Petty said.

The approach may not solve the aircraft cooling problem, but it can greatly reduce the designer's of the aircraft equipment designer's cooling problems, particularly in better, more reliable equipment, Petty said.

Petty warned that if the cooling system designer does not establish his heat exchanger early in the system design and design installation of equipment accordingly, the cooling system can become a valuable monitor isolating the aircraft with reduced weight due to heating and cooling and operating at low efficiency.

Lubricant insulation is a valuable tool in reducing and improving reliability, according to J. D. Goode, chief of tribology, Convair, Ft. Worth. Goode delivered a paper on lubrication design evaluation.

Some basic recommendations should be developed from overall weapon system requirements, seeking possible more intelligent and efficient work in all phases of lubrication evaluation, Goode said.

This background knowledge is particularly valuable when the need for a compromise arises in an area where the requirement is somewhat stringent but often requires interpretation, he said.

Early Stages

Analytical evaluation of subsystem functional designs in the early design stages permit usage of more complete airflow data and effect subsystem data, and can point up improvements which can be made most economically and effectively, Goode said.

The Convair spokesman, though pointed out that this evaluation is not repetition of previous subsystem analysis but is an approach that takes full advantage of latest knowledge of the aerodynamic and heat transfer processes.

Final phase of evaluation is experimental testing in the laboratory and in flight. Goode said that his functional evaluation, the most fruitful laboratory

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with
C.A.E. Turbine Power

Air Corps flight training routines took a significant step forward recently, when the T-37 twin jet trainer entered its Flame VIB Testing at Barksdale Air Base, Louisiana. Twenty hard-picked officers embarked on a course known as PROJECT PALM, with the two-way goal of training for them, and conducting testing for the plane. Their new high-performance ship advances the jet plane at first, training in an earlier stage in the training schedule, operating the flame canister from propeller-driven planes to jets, with gains in both safety and economy. Twin 200-T-7 turbines by C.A.E. provide the power.



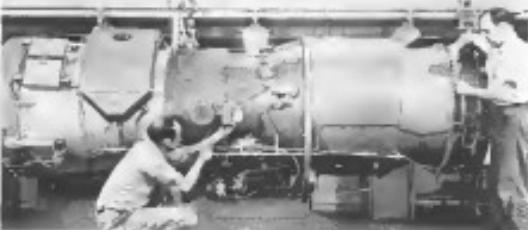
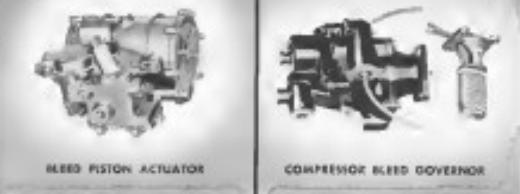
CONTINENTAL AVIATION & ENGINEERING CORPORATION

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Holley
engine
controls
selected for
JT4 engines
on America's
first jet
airliner



Powered by four JT4 Pratt & Whitney Aircraft engines, the Boeing 707-320 will carry 131 first class passengers from New York non-stop to the Continent in just over six hours. Each of these new engines, commercial counterparts to the F-104 which drives many of America's best jet fighters, delivers up to 15,000 pounds of thrust. Able to pack so much added power into a relatively small space at the result of designing engine components which will operate at higher efficiency, engine life and reduce overall weight.

Holley Carburetor Company, work-

ing closely with Pratt & Whitney Aircraft engineers, carried out the exacting development on such vital engine components as: the compressor bleed governor, and the bleed

governor actuator. For single and multi-engine military aircraft, the Holley multi fuel control is a component unit to the Holley governor and actuator.



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tors are those using insulation, usually of the asbestos, but sometimes of other substances in the plane, insulation and other physical anomalies we brought to light and appear in a quantity form.

Consequently, he said, the value of the tests can be greatly enhanced if they are both preceded and followed by laboratory simulation work. Flight testing of a modern weapon system is a long undertaking covering many subsystems and pieces of equipment after the subsystem being evaluated, he pointed out, and war conditions are sometimes difficult to control.

Many of these problems can be minimized or eliminated in laboratory simulation, Gehrke said, with the result that a simulation setup is effective in reproducing troubles encountered in flight.

Thin Wings of CF-105 Influence Hydraulics

Detroit—Designers of the Avco CF-105 Arrow were forced to use a 4,000 psi instead of the usual 2,800-3,000 psi hydraulic pressure because of limited space for elevator actuators in the outer wing leading edge. A. S. Wood of Avco told the annual Vickers Hydraulics Conference here.

Each actuator had to exert a distance output exceeding 54,653 lb at 40 deg/sec. elevator movement and was required to fit alongside sets of the retracted gear housed in the leading section of the thin wing section.

An interior of 5,000 psi was considered but was felt to be beyond the present state of hydraulic equipment at. At it was, Avco had difficulties in finding equipment for the high pressure system. Wood said most of the equipment is now ready and is being ground checked before flight test of the CF-105. The 10-gauge aluminum and titanium plates the aircraft's three leading edge sections are currently being qualified at Vickers. Though leading edge skins have been extremely strong, Wood said, the pump (Vickers PV 911) appears somewhat.

Once the highest pressure was accepted, Avco found that it was easier to fit the set of the hydraulic equipment throughout the plane. This is ample documentation one could be cast standard size smaller than 3,000 psi system and it was easier to squeeze the pump on the engine gear boxes. Because of the higher pressure available, it was easier to obtain the leading gear wires than the fine strands allowed by the supersonic fighter's rigid requirements.

Thus independent to discolor systems are used on the CF-105, two for the sodium actuated flight controls and one



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To protect jetliners from hydraulic fluid fires . . .

TWA SPECIFIES SKYDROL 500 FOR CONVAIR 880 JET FLEET

For improved protection against hydraulic fluid fires, all 30 jetliners in Trans World Airlines' new Convair 880 fleet will come factory-equipped with Skydrol 500, fire-resistant hydraulic fluid.

Skydrol is the practical solution to concern about danger from hydraulic fluid leaks. It is a fire-resistant, lubricating chemical, not an oil. Today, more than 700 airplanes in 40 of the world's major airlines are protected by Skydrol. They have logged over 8,000,000 flying hours... overwhelming proof that Skydrol gives pretti-

est operation. Tomorrow, when a TWA Convair 880 speeds from New York to Los Angeles just a step behind the sun, it will enjoy peace of mind from Skydrol 500, fire-resistant hydraulic fluid.

Jet- or propeller-powered, there's a Skydrol for your aircraft. Conversion from your present fluid is easy and costs comparatively little at overhaul time. Or, if you're ordering new aircraft, simply specify a Skydrol fire-safe hydraulic system as original equipment. Protect your planes and passengers from threat of a hydraulic fluid fire. Be safe...with Skydrol.

40 Major Airlines Now Specifying Or Using Skydrol...

LAN	Western	Canaian Pacific
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Embraer	Swissair	British Airlines
Slick	United	Pasific Air Fred
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CNA	Brussels	A V R (Brazil)
KLM	Delta	Philippine Airlines
LAK	Northeast	TCA
TAI	Northeast	SAS
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National	Fiji Airways	TWA
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Russians Exhibit Coaxial Rotor Ka-15 Helicopter



Russian Ka-12T two-seater helicopter, pictured here, was recently being displayed at Moscow's N. I. Kotovskii Museum of the aircraft. The manufacturing nation has planned to use 215 hp engine. Maximum speed is reported to be 95 mph., and cruise speed is 76 mph. The two-passenger craft has a range of 210 hr., and a ceiling of 10,000 ft. Klimov created two designs utilizing the dual coaxial rotor concept for Ka15, which is now in production in a three and six-passenger pod control version, and the larger Ka-15 which can carry four passengers. Klimov has indicated that his next helicopter design will be powered by gas turbines (AVW Aug. 12, p. 33).



AVIATION WEEK, November 23, 1967



CL-41 JET TRAINER MOCKUP shows mounting of horizontal tail above vertical fin. Twin rudders on either side of fuselage will lead high tailfin, which will extend at tail. Mockup facilitates presentation of carrier flight to provide evaluation of cockpit vision.

Canadair Stresses Versatility in Trainer

Canadair, Ltd., Montreal is spending development of its new side-by-side seating CL-41 jet trainer by breaking two prototypes scheduled for completion in fall of 1968.

Development of the jet, in the wind tunnel and cockpit stages until in flight, was first revealed in Aviation Week (Jan. 28, p. 71).

Initially designed to fill primary through basic flight training missions, Canadair CL-41 jet is also planned for additional roles. Company expects future developments of the basic CL-41:

- Ground support role in addition to primary training will be possible through use of an omnidirectional pulley system in cockpit air design.
- Four-place multiplace version, probably, will also be available in overall arrangement of the CL-41's interior. Such modification would make the airplane suitable for a variety of applications, including high-speed transport of important officials, also possibly as a light jet executive transport for businessmen.

CL-41 project works the first airplane designed and built from scratch by the Canadian aircraft industry, exclusive of Canadian Division of Hawker Siddeley. Although its primary mission is concentrated in basic training of other manufacturer's airplanes, such as the North American T-38 series, Lockheed T-33, Douglas DC-4 and most recently extensively redesigned versions of the British BAC

both piston and turboprop models

Indications are that Canadair is seeking a wide market for its CL-41 in military training but has been checked not only in Royal Canadian Air Force, but also U. S. Air Force and Navy. Also, the company notes that the airplane's span and maximum chord length are designed to satisfy both U. S. and British criteria, which differ somewhat.

A single席位 of the latest light-weight design and low specific fuel consumption, developing approximately 2,000 lb. thrust, will be utilized initially.



SIDE-BY-SIDE SEATING will be used to prevent close identification between instructor and student. Cargo version will include pressurization and ejection seats.

ing the General Electric J85 or Fairchild J85 are strong contenders.

Measuring 16 ft. 6 in. wide, 31 ft. 11 in. length and 9 ft. 6 in. height, the CL-41 has a weight of 220 lb. (t), a wing loading of 14.4 lb./sq. ft. and power loading (rated) of 5.5 lb./sq. foot. Dragged gross weight is 6,735 lb.

Performance characteristics are fast, but at 1,000 ft. offload ground may, 1,760 ft. ground takeoff run over 100 ft. altitude. Rolling speed, at intermediate weight, would be 62 ft. maximum speed at military power or intermediate weight is planned at 400 ft. and maximum speed at maximum power at intermediate weight is 585 ft.

Fuel Load

Fuel load of approximately 2,000 lb. will be pressurized, giving the engine a non-linear flight training curve at sea level without refueling. At altitude, with fuel reserve of 10%, the CL-41 would have a range of 600 nautical miles at an average speed of 700 ft.

Corkett is pleased to incorporate modern combat type equipment, including cockpit seats, survivability can op, separated into the seat section system, other survivability, two can op, pilot instrument flight panels and head-up windshield.

Overall director of the project is W. K. Ebel, production project engineer, and F. G. Scholten, E. H. Higgins is CL-41 project manager and F. C. Phillips is project engineer.



J75 Turbojet Passes Company Tests

New afterburner model of Pratt & Whitney 30,000 lb. thrust turbojet engine, used on several aircraft, has passed company tests during tests of the Naval Air Warfare Test Station, Pomona, N. J. Engine, tested under all potential altitude and speed conditions, is the first aircraft engine to have its performance guaranteed under actual altitude operating conditions and the first to have, which met two guarantees, the ratings and targets it selected for Reynolds F100, Convair F106, Convair Vought F8U-1 and Martin 216L.

PRODUCTION BRIEFING

Test Engineering at Marquardt



By
Roy E. Marquardt
President

Unique among air-breathing engines, the rocket cannot run independently on the ground. Because ramps depend on their velocity through surrounding air masses for emergency or combustion air, intricate test facilities must be provided.

Marquardt Jet Laboratory simulates these high-speed, high-altitude flight conditions during ground testing. A USAF facility, combined with special DOD test facilities, MJI is one of the most extensive in existence today. Valued at \$15 million and occupying 3 acres of land, this dynamically functional engineering tool maintains the number one costly test and error flights of any organization.

Ground test cells, with associated instrumentation and computers, permit sea-level and altitude testing of full size and test-scale models. In our two sea-level test cells, high pressure air is directed over the test engine through sonic, sonic and supersonic nozzles, and exhausted to the atmosphere. Turbulence is ingeniously utilized in two full scale engine altitude test chambers to simulate heated and rarefied air conditions encountered by high-speed supersonic aircraft.

A third configuration of both sea-level and altitude cells permits simulation of the free jet nozzle. This allows evaluation of the effects of varying angles of attack likely to be encountered by operational supersonic aircraft.

A new production assistance test facility now being built in conjunction with our Optics program plan will greatly supplement the up-to-the-minute equipment furnished the Marquardt Test Team.

Within this division, engineering

operations test for:

Instrumentation, Aerospace Electronics

Electrical Devices, Computer Components

For information about these positions and the professional engineering environment at Marquardt, we invite you to write Jim Duke, Professional Personnel, today.

Roy E. Marquardt

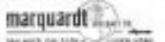


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To Test Engineers Facing an ENGINEER | BARRIER *



Marquardt Means Opportunity — Test engineers no longer feel hampered by the limit of stimulating projects. At Marquardt Aircraft, the company where an engineer's "barrier" has never existed, your work will span a broad range of supersonic propulsion problems. Look to your future by writing to Marquardt, today. Address your inquiries to Jim Duke, Professional Personnel, 16551 Satin River, Van Nuys, California.



Published above: Ralph Davis, Chief Engineer, The John Deere

ENGINEER | BARRIER — an achievement level beyond which you cannot advance



how specs have changed!

On December 23, 1967, the "Original American Army Contract for Avioplant" was issued Specification Number 8-500.

"It should be so designed as to ascend in any canopy which may be necessary in field service. The ejection device must be simple and inexpensive. It should also land in a field without damaging its structure."

That was a pretty tough problem in 1967. As planes took off and landed at higher speeds, the problems got tougher. Some of the answers have come from L. O. F. Examples: Development of *Eva-stop*[®] for windshields to give pilots perfect visibility despite friend/flying conditions. Examples in Cessna's "KL-38", Lockheed's "C-130", Douglas' "C-123" and Boeing's "KC-135", among others.

If you have any question concerning the latest develop-

ments in aircraft glass, send it to Avioplant Division, Dept 73117, Libbey-Owens-Ford Glass Company, 485 Madison Avenue, Toledo 3, Ohio.

In any event, write for a copy of *The Original American Army Contract for Avioplant* available for viewing.



LIBBEY·OWENS·FORD a Great Name in Glass
TOLEDO 3, OHIO

ents, studio for their USAF ICBMs. It is not known what Bell is using for fasteners.

"*Operation Bumper*," Allison Div., General Motors (GM) works was recently with a YC-134C equipped with Allison 601-D17 turboprop engines and Avco produced 666 four-bladed propellers. The major-pusher combination is the one that will be used on the Lockheed Electra commercial aircraft. Objective of "*Operation Bumper*" and Allison, was to obtain 7,000 flight hours in the shortest possible time under both military and commercial transport new delivery. Allison hopes also to demonstrate the value of converting existing aircraft such as the Convair 580 to its gas turbines.

Seribane may be the answer to avoid far higher performance, weight increased materials if it can be produced in small quantities at reasonable prices, according to Maj. Gen. Wilson G. Sester, USAF procurement staff at the Materiel Command Headquarters, Dayton, Ohio. Seribane is six times stronger than steel on a strength-to-weight basis, weighs about a third as much as aluminum and will withstand 1,600°F temperatures according to Senter. Because Seribane is not yet being used, neither its high cost (\$39 per pound against \$10 for titanium) and \$12 for stainless steel) and heat-treatment time and expense matter.

Boring Aircraft Co.'s Boring missile development engineers are using polyethylene plastic plates shot-holed 1/16" off to provide effect of a temperature-resistant flexible wire strain shims.

Depending on the load requirements, the plates' speed-vibration range, from 2,200 to 4,500 cpm (Roughly March 30). In use of fasten to firmly the nozzle, through a sleeve through a small hole in a nozzle guard, through two pieces of paper used to insulate the jetlets' sheath, and through an open outer case into an area where the begin, a sample of the Boring's skin, is being tested to 400°F. Length of flight is 600 feet. Boring and the plane engineers disagree on impact, having had a good track to show where they fit.

Stanford Research Institute, Menlo Park, Calif., has attempted to offset the adverse effects of cushion materials upon epoxy bonding adhesives by introducing its "catalyst" additives and test-rubber compounds. Research which is being carried out with USAF funds has shown that radiation damage to epoxy will take two forms cross-linking to form interpenetrates and otherwise rupturing of desirable bonds of the polymer.

FASTENER PROBLEM



Miniature right-angle stop nut for cover hold-down saves space and weight on avionic unit

Then a United Control Corporation's advanced Mater. Warfare System. Control-designed and developed to reveal any unusual vibration frequencies. It is used in the aircraft industry, especially P-15 Thermometers and like all other avionic components that represent must be lightweight, compact and highly dependable.

THE PROBLEM: How to attach a dual cover securely, with provisions for easy removal for inspection and a high degree of fatigue-resistance. Yet the fastening job had to be done within minimum weight and space constraints.

THE SOLUTION:

Type ADTM—especially developed for blind mounting application, with a high torque-shear locking insert, provided the user at "A built-in" shear" permits the nut to be self-locking to accommodate for a sensible amount of misalignment between nut and part. If the torque-shear limit is exceeded, ESNA could have developed Type LEAD77 which has the same features as Type ADTM plus an alternate type of locking device which withstands shear up to 500-lbf.

YOUR FASTENER PROBLEM can be solved in early and efficiently at the right-angle hold-down application. Let us help you find that answer today!

MAIL COUPON FOR DESIGN INFORMATION
Dept. MIL-1000, Micro Stop Nut Corporation of America
2330 Vassarland Road, Union, New Jersey

Please send me the following fastener information:

- Sheet metal or T-type
ADTM and Type LEAD77
- I am enclosing a drawing of my product
What catalog number is my part?

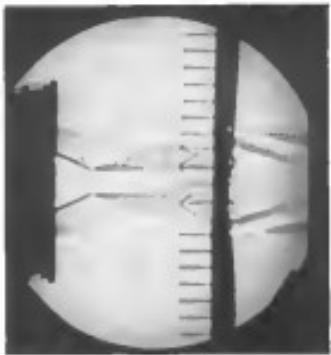
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ESNA is a line of ergonomic fasteners. These unique fasteners reduce weight and volume while reducing the size of the structure. The ADT is designed for where space is no problem, the other two, the ADTM and LEAD77, are high pressure resistance materials (PA6/PA12).



MISSILE ENGINEERING



SCHLIEREN photos show expansion fan released from model engine. Head classifier in center flow of altitude. Apparent air level pressure (left) with expansion exhaust at right edge. Photo right represents 20,000 ft where center zone begins ordering.

Rocketdyne Develops Missile Engines Now,

By Richard Sweeney

Chicago, Ill., Calif.-Dowdell, to play a key role in ballistic missiles today and space vehicles tomorrow. High-energy propellant systems are being advanced through research and test at the extensive facilities of North American Aviation's Rocketdyne Division here.

While large liquid-propellant rocket engines for Air Force Thor, Atlas, Cavat and Jupiter are being thoroughly refined in various configurations, solid-propellant rockets, monopropellants and fuels, including other schemes for a wide variety of applications are being conceived and evaluated on project and train basis, in some cases, side-by-side.

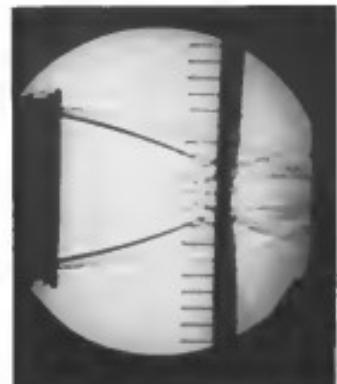
Rocketdyne participation in the large liquid-propellant field stems from a North American corporate decision in 1941 that missiles will be important in future defense plans and therefore the company should immediately establish itself in the field.

One of several companies awarded a study and research contract on a missile system, North American established 12-months ago a group in Job, 1949. Dual-purpose purpose was to work on that contract and to develop simultaneously anti-aircraft-based missile capability.

Following a company decision that



VADUMM wind tunnel, when the off photo on the page was made, it operated for Rocketdyne to test rocket engine components. Technician, Glass Rosley, and Audit Staff are fitting part to test equipment. Rocket engine bellmouth nozzle at right is receiving performance tests. Low pressure intake is a preliminary drag test at which nozzle shapes are investigated for exhaust pressure velocity.



RDW patterns at 30,000 ft. (left) and 30,000 ft. (right) show simulated expansion. Air inlet, which shock waves are forming, is at center. Wind pattern is at left. Photo right is at sonic vacuum of space and goes from expanded beyond upstream point (below).

Studies Space

five major areas of aerospace research—missile guidance and fire, liquid rockets, metal study, the original atmosphere and gathered and digested all available data on German rocket work, processed them there into one evaluation according to science. That resulted in formation of:

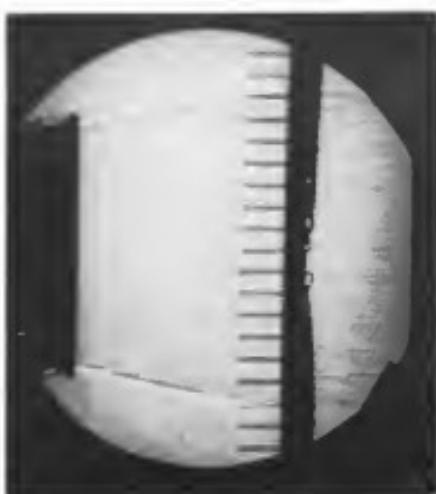
- Rocketdyne, for propulsion system
- Antares, for guidance, electronics system

■ Missile Development Division (MDD) for overall missile systems.

■ Atomic Instrumentation, which got a start early with involving feasibility of nuclear power for an airborne weapon system. Study showed that gaseous hydrogen is ideal. From the correct instrumentation, a complete staff and bank of knowledge were assembled and the group started almost with its commercial nuclear work.

Under present organization, divisions operate on contracts according to their specialties. Specifically, if Missile Development Division requires a missile system, Rocketdyne bid against all contractors for the propulsion system. Another division has open competition for guidance and electronics contractor. By same token, divisions are free to bid on contracts with other point-and-sweep system contractors.

Divisions philosophy, structure and





Surviving Impact is an Eimac Ceramic Tube Extra

Aeronautical electronics demands extras from vacuum tubes. Among them is the ability to withstand heavy impact without impairing electrical characteristics. The photograph dramatically shows what happens to a 250 watt glass envelope tube and an Eimac 200 watt ceramic tube when both are dropped from a height of seven feet. The ceramic tube "bounces."

Other advantages of Eimac ceramic tubes are: resistance to damage by vibration and temperature; smaller size without sacrificing power; ability to undergo optimum processing techniques that lead to tube reliability and longevity.

For further information, consult our Application Engineering Department.

EITEL-MCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
Eimac First with Ceramic Tubes that can take it



The small Eimac ceramic 4CR300A, shown above, will withstand 500 shocks of 11 millisecond duration. It will operate in extreme or general station service of fall ratings up to 500m/s.

In its new line of ceramic tubes, Eimac has the answer for the aeronautical engineer who needs a tube that will deliver full output under extreme environments.

4CR300A HARMONIC RATINGS TO 500m/s			
FREQUENCY	FM	MM	SSB
E-C Plate Voltage	3000	1500	2000
E-E Screen Voltage	300	300	400
D-C Grid Voltage	-250	-250	-
E-C Plate Current	250	250	250
Plate Dissipation watts	300	300	300
Screen Dissipation watts	17	17	17
Grid Dissipation watts	2	2	2

management policy. Rockford has six cells below in the top to the senior officer's private leadership in large liquid rocket engines which are used in USAF, Army and Navy projects. Rockford achieved full division status in 1981, but had been making steady gains in management and other company techniques during preceding 18 months.

Division's Freedom

Divine management gets policy guidance from corporate officials, is autonomous to do its own operations. Profit and loss are up to division management. Divine has capital funds at its disposal sufficient for normal expansion.

Internally, Rockford is organized hierarchically. Base units are divisions, plus services, engineering and manufacturing. In line with past and present business, quality control is a base function rather than a part of one other group.

Engineering is broken down into product design, design and development, test operations, research and administration.

Research, under Director John Fausch, is planned and directed rather than being assigned toward application in general or aircraft specific. Operating, according to Torrence, was kept behind the base research. The service tries demonstration of solid fuel, research centers or Bureau of Standards, and developed codes are written for aircraft, missiles and fire radars.

Rockford's prime role, however, is generating nuclear photons away from electrons. Two years ago, photons per second increased in the aircraft, now a steady establishment is integral part of research work.

Much of research efforts are devoted toward resolution, heat transfer, polarization. The researchers have a hydrogenation laboratory equal to or better than those maintained by NASA and universities.

New Products

While work on hypersonic fuels currently receives greatest attention, new areas are not neglected. Research on currents has started to follow the free radical path looking toward the next generation of rocket engine fuels.

Work is being accomplished on heat transfer associated with combustion in nozzle type engines, as well as in both heat and pressure fields of detonation.

A problem for researchers, Torrence points out, is the facilities and equipment required for detonation characterization. Since rocket engine work is comparatively new, Rockford's research needs frequency has to design equipment and facilities aimed at its own



Lockheed's F/A-18 Starfighter

Reaching for the Stars

With its new air scoop design, high T-shaped tail and knife-blade wings (just 21 feet, 11 inches from wingtip to wingtip), Lockheed's F/A-18 Starfighter is America's fastest fighter. It flies so high and so fast that pilots almost feel they are running out of sky room.

The Starfighter performs near the fringe of today's understanding of aerodynamics, and incorporates six design unusual features surprised by the most recent developments in the field. Because of its advanced design, many new questions arose, questions which were answered through extensive wind tunnel testing.

CWT—the Southern California Cooperative Wind Tunnel—played a vital part in this testing. Throughout its development, many hours were spent by CWT's staff in gathering data on the F/A-18's aerodynamic behavior. The success of this work is reflected in the Starfighter's performance record.

The CWT is responsible for testing many of the nation's most important aircraft and missiles. In addition to its five major components, CWT also serves other leading aircraft firms and government agencies.

If you would like more information regarding the CWT's facilities, or information regarding employment, please write us.



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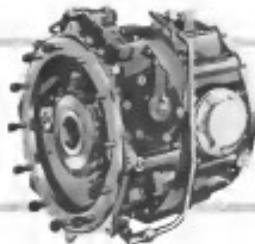
SUNDSTRAND DRIVES

Ability to hit a distant target is the only measure of a missile's effectiveness.

That and the ability to carry either nuclear or thermosonde weapons are characteristic of both Northrop's Snark and Chance-Vought's Regulus II, for the USAF and the Navy respectively. To accomplish their vital military mission, all components must function perfectly during long-range cruising. A reliable electrical system is mandatory; for guidance and other electrically powered functions, Sundstrand Constant Speed Drives provide compact and lightweight generating propulsion with both the capacity and stability necessary for optimum performance. They are two more in a constantly growing list of applications with outstanding records for reliability and performance that keep Sundstrand first in constant speed drives.

WIDE RANGE OF MODELS

"Snark-Type" Sundstrand Drives will fit the Snark supports alternators on dc output shaft while a "Pacemaker-Type" unit powers the generator in the Regulus. More than 20 custom-engineered models of Sundstrand Drives have been installed successfully every type of monoplane aircraft as well as in missile applications.



**SUNDSTRAND
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DIVISION OF SUNDSTRAND MACHINE TOOL COMPANY • ROCKFORD, ILLINOIS

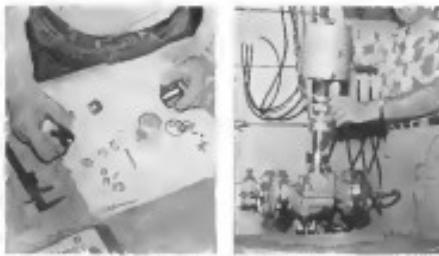
Sundstrand-Denver Division, Colorado

Western District Office, Hawthorne, California

CONSTANT SPEED DRIVES • AIRCRAFT ACCESSORIES



VALVES for liquid oxygen rocket motors are checked out at Rocketdyne's Santa Susana Equipment Laboratory before motor is fired. Mechanics (above) are running a check.



CARE with which components are handled is illustrated by machinist's white glove (left). Valve being set in test bay before checking (right).

particular requirements, among a need for safety in travel, that is causing people skilled enough in their own fields to be unable to design equipment for the industry, a point which could reasonably bring personnel enough to accomplish certain work.

Nasa's main contractor at the two-prime field laboratory at the Santa Susana, about 10 mi from present offices, is a half-million-dollar research building.

One major problem continuing in Rocketdyne research, according to Torrey, is in the mathematical subtlety of those posing the system. Proven with the difficulty in the schools, which still teach the same mathematics for engineering and science courses taught years ago. An interesting problem was first shown him by a schoolmathematician close to the higher base in current industrial use.

As example, Torrey said, is the of problem of flows which many now approach as not understand or have

had to in acquire expensive tests and laborious investigations. Due to financial considerations, his theory has to expand the problem to include other types of systems, such as the one he cited that discusses magnetic resonance both in it and me often though they are unfamiliar with the theory.

Concerning money for research, Torrey stated there is no death at all of financial support for worthy projects. Major research work must have merit and for that, there is an angle firmly. However, one catch is that, while the idea, researchers sometimes seem to want the answer in order to sell acceptance of the problem. Major parts of research proposals come down to the Indian, Torrey said, but sometimes the writers approach the question to tackle a squirrel tail.

When a research field finds a problem, according to Torrey, yet is not enough along to be made into a formal proposal for research project contracted to a source, enough funds are available to bring the work to the stage

when it can be wrapped into a proposal. Once again, he points out, proposals have to be fully well founded before much entry will be approved.

Torrey indicated that Rocketdyne, his emblematic extensive study with solid propellant rocket engines, but he believes two future paths, along with liquid propellants for long-range aircraft the inherent feasibility of liquid propellant engines and a narrowing of the completely gap in width made for lighter thrust levels and improved flexibility to make them operationally worthwhile.

Preliminary Design

Scope of Preliminary Design: George Sutera, n. mkt. Activities include:

- Commercial product studies
- Propulsion system analysis, determining whether market programme is best for a particular application. Rocketdyne's mission in the field is such that customers frequently consult Pre-launch Design people when formulating requirements for a particular application.
- Preparation of proposals for designs
- In-house studies of nozzle, contour flow, cluster configurations. Current focus is on the development of a series of guns, originally, however, is also application of this work.
- New-space applications such as new Navy aircraft booster engine (AW Nov. 18, p. 23).
- Advanced studies such as those involving the Space Shuttle space vehicle with its programme currently behind the most logical first step in customized propulsion systems (AW April 4, p. 27).

An area where preliminary design finds a home with lead is in propulsion system control, with respect to interactions between engines and guidance systems.

Alternate Approaches

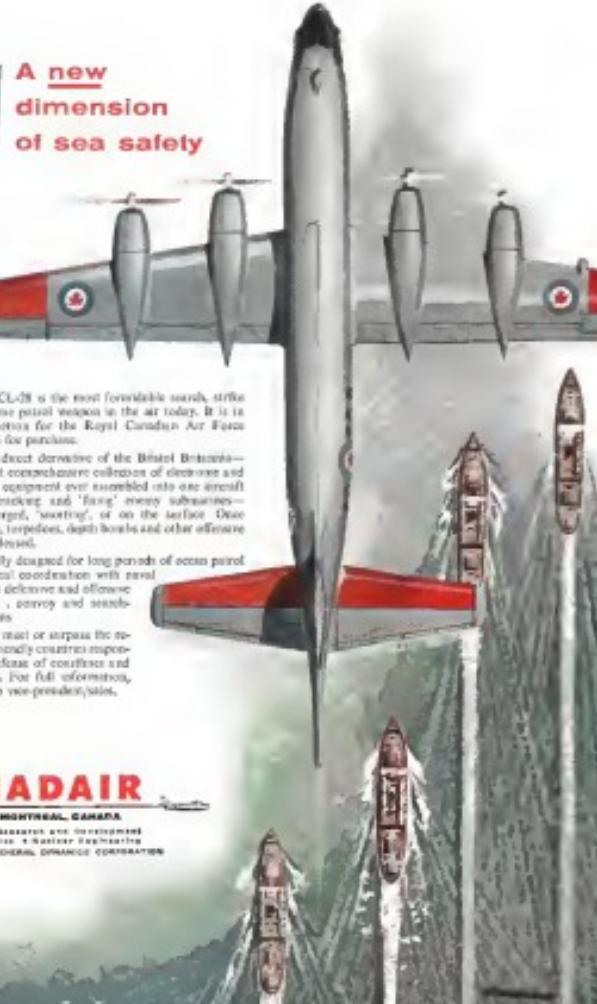
Four conditions dictating different approaches and degrees of exploratory work in preliminary design, continue, are whether a missile is compared to a trajectory, follows the same general path each flight, or whether it has a strong trajectory constraint such that conditions require small variations in flight path, so lead needs a wide range to fulfill its mission.

Completing these parts of propulsion systems which provide guidance are final growth into charged thrust vector response required analysis covering all aspects of operation. Typical is the logic, knowledge, joint and steering areas which are the basis of a generated rocket engine.

One development the section presented in its work is a double ended rocket motor for measurement of thrust



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Avco today

Avco sends a message via meteor

Burstly, in the far-flung front of the exploding nation test high in the atmosphere. Codex researchers signal a practical way to transmit high-frequency radio signals around the curve of the earth's surface. They did it with a kind of orbital "bulletin board" by "bouncing" the start-of-a-meteor trail at work, so angle that the reflected wave hits a distant destination—far over the horizon. This "bounce-sounding" technique has transmission losses taken for more readily and less expense in equipment. 260,000-ton solid-fuelled instrument and testing by the Research and Advanced Development Division. "Sustent sounding" is another breakthrough by Avco.

THIS IS AVCO

Avco today is one of America's most diversified makers of defense and industrial products. An avo's Codex Division problem solved structures and electronic systems, Avco's Lycoming Division is America's leading source of aircraft power in the civilian aerospace range. Avco's Research and Advanced Development Division performs missile and aircraft research. Other Avco divisions and subsidiaries are: American Radiance... New England Lamp Works... lamp and lamp equipment... Codex Broadcasting Corporation... Atlantic Liner... Canada... commercial gas and lumber exporters.

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vacuum. Different throat choices and widths of turning configuration are considered on the equipment.

Another performance change tool is the low pressure tunnel scheme can out acoustic shapes are investigated for a desired pattern, velocity. Low chamber pressure producing during nozzle discharge simulates flow patterns at low altitude have low level in static atmosphere.

One of Rockford's biggest assets is Propulsion Field Laboratory, 1,700 acres on the Santa Susana Mountain, not far from the heart Canyon Park, where terrain is well suited to large engine test stands.

Early Tests

Began in 1947, when North American acquired a few hundred acres Propulsion Field Laboratory. And the first firing of a large engine started shoulder and upper assembly, in February, 1950. Personnel then assembled 15, tests were at the rate of two or three per week, and after each firing a critique was held at which all observations of everyone present, how can next enough test stand, were made.

As things began, Rockford faced a community relations problem in getting the large San Fernando Valley population to the area, where shooting sounds. Today the sounds are largely ignored. Although Rockford's per vessel have become far enough in understanding so it often finds and sound pulse front atmospheric conditions seriously will benefit sound to distant residential areas, creating an upset.

At the start of the Propulsion Field Laboratory, North American had trials with its own engines, and not the equipment for the missile pad to be USAF. Later, North American bought some land and USAF built stands for Rockford to operate.

Mission Stands

The test laboratory now has 22 test stands in operation, some with walls that are flammable, plastic, glass fiber, composite test laboratories for gas gas turbine, turbopump, rocket engines starting material. A metal composite laboratory, made of concrete. Can handle thrust chamber, nozzle, injector stand and at the components laboratory. This new laboratory, under construction, will be able to test flight hardware, even large size and will be used once enough time comes to complete capsule test rig.

In addition to those at Propulsion Field Laboratory, Rockford has open air test stands at Edwards Air Force Base, Edwards, Ala., and at Nizhniy Novgorod, Russia. Edwards stand does closed loop testing. Novgorod is used for

propulsion testing, and Novgorod, ultimate and afterburner engines are being performed, data strictly production testing. Both production and development testing are done at Propulsion Field Laboratory.

Critical philosophy of development test is to insure that a finished product will return to its customer, with all components developed to a state which is representative and cost efficient.

Production testing selects engines to a required number of flights, the critical point of solid-engine operation, and our tests are sufficient to disclose defects without exceeding the growth on mission life.

Workshop at Propulsion Field Laboratory include provision for systematic evaluation of flows, a useful component we tested first, then as suitable, then engine. For research, research, liquid nitrogen is used on one side of a test when IP 4 is tested though, and the opposite can be water substituted for fire when liquid oxygen is run through.

These test stands and these control tools are grouped in three or four groups. One group is natural products in terms of rock, another, soil, a third of concrete of rock, structures in deflected. Under zero atmosphere, natural fuel tanks and liquid oxygen storage

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New Bulletin P-1099 tells about other up-to-the-minute Oakite materials and methods for specific aviation cleaning problems. Write Oakite Products, Inc., 55 Foster Street, New York 6, N.Y.



East River Office: 600 Madison Avenue, New York 22, N.Y.

is total at each site. Rockford Field Laboratories has a liquid oxygen plant, from which feeders run to each test stand. The pressure from these to test stands is increased. Fuel trailers in from remote depots are loaded on land or by truck to a stand at a time.

Heights are stored at several strategic locations down which they can be paid to move them for fueling areas.

Opportunity Bonus

Although general test programs are outlined by an advance planning group testing at the stands is conducted on an opportunity basis to some extent. Since a test may be scheduled in one stand, in my case only, it is left to a fuel distributor to find another stand in the area, or to close to a first, if all go well. The earlier scheduled stand will work, either than the one the customer and his position are asked. Since more time will be allotted at all but critical center personnel time is left for mechanics and technicians who are sent back to a stand that is formed when a firing is done. By the time, methods which are being formed to upgrade general knowledge of systems in the fields related to these work.

Safety programs are quite严格. Workers are kept fully aware of hazards accompanying materials they work with, resulting in an excellent safety record despite nature of the work.

To obtain licenses from several test work, certain exhausts have been reduced to a number of standards. One can see effects of exhaust on radio and television stations which cannot have to pass through exhaust or some part of flight. Some afterburner was forced, but less

than had been anticipated. A second investigation was on new concepts.

Radiation test people have had to design much of their own specialized equipment such as the 100,000 rad/sec dosimeter and the ionizing water system which allows protection there during an engine run. They have already shown that small enough with flight as its place to their own purposes. One is a 1,200-lb. d-c generator formerly used as an ionization tank, now built in 1951. The same man who ran it for the test has operated it for Rockford's Descent power plant, 1,300 hp. World War II submarine motors. Combination driven propellant turbopumps at operational speed without resorting to gas generation for each fuel.

Another special test developed by Rockford is combustion instability research. Investigation shows the best burn duration took 4 sec. to cut off an engine after seeing oscillations, viewing it and actuating cutoff button. Often, before a combustion was visible, flame deflections were burned. Combustion stability analysis causes oscillations over long time periods. 20 millisecond test of the chamber is set up of burst pressure & automatically cuts off the gas. It is sensitive to oscillations in propellant extensions in combustion stability.

Firing further generates during each run a number of transients with unique characteristics per period of low frequency. These must be analyzed and must be resolved or resolved, as to the rate. Concentration on the thermal is to protect expensive equipment, standards, facilities and equipment.

Of the 1,200 people at test operations, 30% work in instrumentation, the biggest problems are of the testing regeneration. Majority of attention is

paid to cohesive fuel instrumentation, but a number of people are engaged in instrumentation research.

A basic need for routine work is to characterize accurately the nature of solid rocket engines. In this data on these particular characteristics will accompany the engine into service and permit accurate flight programming at operational rates.

In routine test instrumentation, temperature in the low stage are the easiest handled in liquid hydrogen work, measurement to 10 deg. a. easier is required but better accuracy is desired.

Instrumentation people would like to measure high and low temperatures gradually to +7 deg over a 30 deg gradient. Since they do not have the facilities for solid instability and to operate temperatures in the problem to get readings on a steady state basis.

High temperature areas fall in generators and turbopump nozzles, at temperatures as well as in throat chamber. While generators and pumps are expected to remain stable for some time, they face much higher temperatures in turbopump nozzle exit the propellant picture in the due for higher specific impulses. Currently, a full scale program has been initiated to determine what instrumentation method will be used in these over 5,000 rpm regions. A literature search is under way, a small test made of thermocouple studies.

Temperature Problems

Most fuels, where temperature plays a part, is a severe problem. Anomalous here was at the order of 1.25%, but insulation level in the digester is low and even greater anomalies in growth cause. Temperature transients are the beginning, and while frequency response up to 10,000 cps is obtained, accuracy of magnitude of variations is the weak point.

Vibration tests, including transients, are under good control with torque, frequency, up to 25 deg.

An instrument pressure transducer mentioned some trouble spots in obtaining high frequency data such as accelerometers and pressure near the engine while it runs, was under test for over more than 130 deg. Concrete block houses, acoustics isolated are used.

Instrumentation has low and turns out an motor problem, with 10 cps, expensive to drive in. However, and difficult due to weather protection of controls still recent.

Routine test instrumentation is now being tested about the instrumentation low Digital On-Line Transducer, is actually high speed analog to digital converter which takes raw data from fast read sensor, processes it for IBM 7090 computer on tape, to provide con-



ROCKETDYNE developed engine for Army's Redstone missile, here shown in first stage of project C test vehicle being fired at Cape Canaveral Fla. Note nose accessible service door. (Photo by Defense Department via AP Wire Photo)

puted data faster than it generally is available. Plans are also to use these computers to reconstruct by test data curves at least one per control circuit. Since the computer is at Canoga Park, the original intention was to move some data back to Canoga Park so that engineers could be looking at computed data while a run was still in progress. Presently, tapes are taken to Canoga after runs, and more difficulties have been encountered with the instrumentation digital on line transducers.

Test engineer in control center would also have the transducer readout amplitude to be able to read on screen data. New component test bed order construction is designed around the instrumented digital on-line transducer and will have backup of same standard parts.

New instrumentation at test stands consists of conventional items. In some cases they were originally designed around solid rocket requirements, a large majority around Rockford's apportionments, and have become standard items.

In addition to a combustion stability

monitor, an oscillating Rockford developed device is in a cogeneration and variable induction gear for accurate measurement of air rate and quantity in spite of unique loads and conditions. Signal output has been put as digital form, but the predominating output is analog.

Reliability Check

Stabilized analysis of environmental performance is used to obtain reliability information on the basis of analysis, a correlation based on new collection test information which is constantly fed in to the computer. This is done by using a dual input digital. Both sample and testbed is used and a two channel readout mode. Instrumentation people can subscribe to test engineers fast data, based on recent vibration rates and vibration analysis, will have a constant bandwidth of rms. Status report is checked, reliability of instrumentation as well as acting as a guide for upgrading instruments.

Most critical measurements are now obtained to $\pm 1\%$, but the desired figure is $\pm 0.5\%$. A goal is thrust measurement to $\pm 1\%$ at a 95% confidence level.

and standard procedure is to adjust the sensors to maximize the confidence level.

Current standard is 10% accuracy in an average of all previous measurements and here, low critical pressure measurements always is allowed to decide while effect is directed at upgrading sensors of most critical measurement.

Instrumentation growth needs, as noted in John Wetherington, instrumentation research chief, a new and larger set of standards. He points out that the enterprise is about to increase with a take-off, compared with those measurements on a test stand, and that, that of engine in flight under really varying environments.

Current system has a dynamic configuration on a static standard, he says, and while new aerothermodynamic theory is becoming available to determine thrust and other parameters on a fixed basis, there are no instruments to check the thrust at other standards of measurement in the new area.

Novelty is development of new instruments designed especially for this new area, and work is under way at

Rockford: Key Personnel, Facilities

General manager of Rockford is Sound Hoffman, long time rocket engineer and Wilkins Goff a division general manager. Goff passed North American after leaving Wright-Patterson during World War II.

Chief engineer is T. E. Brown, assisted chief engineer is Paul Vogt. Under him action on Preliminary Design George Setters, Design and Development, W. J. Bertram, Test Operations William Cedric Reynolds, John Terrell.

Manufacturing is headed by Ross Clark, Quality Control by Robert Hough, Service by James McNeely.

J. P. McDonald heads the Norden plant where 600 are employed, building guided missiles and Thor. There are 225,000 sq ft of plant on a 200 acre plot ready.

Canopy parts manufacturing is 516,000 sq ft. There also is a 516,000 sq ft building for propellant storage, 64,000 sq ft of metal buildings. Other divisions include 50,000 sq ft overall.

Employees are about 10,000-12,000 in engineering, 5,000 in manufacturing, 3,000 in service and support activities. Of the 2,300 employed at Precision Field Laboratory, 1,200 are in engineering, remainder are technicians, mechanics etc in service.

The division employs about 2,000 graduate engineers and scientists.

Revolutions to develop instruments which will enable scientists to understand the phenomena which thus develop of instruments as end products.

Research Workshops and test stations which closely with adaptation of the NASA developed spaceborne gyroscope which gives direct measurement of height is at present. This low cost laboratory studies of Earth with flying cross sections of temperature, convection, and rotation while these would remain in orbit during a test stand flying. A program to study of solid columns in the upper and lower solar spectra.

Ultimate aim of the series of Earth science projects is development of instruments which can analyze the solar radiation and yield reliable closed a measurement on a correct standard base, for the column is in essence, the planet. Earth's engine thrust is absorbed by high altitude stage gate load cells which are shell stores.

Exhaust Data

Two data as far as yielding much knowledge in the nature of rocket or launch and on the basis of spectroscopic work, they have now confidence in the temperature measure which was now made.

Working on these specifically designed data they need an research work along more structured basis of space research required resolution of known established constants in measurements as it is still development of engines can be quoted. Their work has included full analysis of operation, and small variations in test data properly resolved reflected the possible design.

Under way is an intense effort to find out why rocket engine combustion is unstable and what part or component is responsible.

This is working toward better control of the short lived acoustic wave slope, once be understanding it they will be able to control it. A great intensity resulting from an engine is flight to produce repeatable thrust records.

One of the most significant gains have been made in probe measurements. Biggest single step is the current method of measuring pressure at the throat closure wall, which exists last minute component operating in contact with gas which are at same thus 5,000.

Researchers are able to make these measurements without distortion in the angle, frequency in phase is available the wave shape of the reading between the probe pressure and reading closure of the closure wall. The fact that need not worry about

New Martin Division

Martin Co. has created a new division to coordinate the business arrangements for licensing of the Navy Marauder aircraft and the Air Force T-33 jet-powered fighter-bomber.

G. T. Weller, the company's corporate vice president manufacturing, will take on additional duties as vice president and general manager of the new division, according to George M. Becker, Martin Co. president.

Becker, which has not yet been named, will also be responsible for the T-33.

Edwin J. Walker, former director of Marauder activities at the Patuxent Air and Space Division, will direct all Marauder activities in the Patuxent Air and Space Division until concluding further test of the latest version variant of the USAF Marauder fighter-bomber.

According to Becker, the last that the team was presented was taken charge of our division at Patuxent is a measure of the company's determination to do its work effectively and to the greatest possible.

detection how easily pasture areas remain at a distance from the given area.

While the instruments do not give a highly accurate direct reading, enough information about the instruments that accurate corrections can be applied. Added to this, the instruments are designed to give a direct digital output, thus allowing a prediction system known as PAPET which compensates for inherent mechanical and electrical distortion present in sensors.

Manufacture of rocket engines is accomplished 98% with standard materials in the majority of specialized equipment being used in inspection.

One unique special setup is used in support head drilling, certain parts being necessary in this operation. Changeover technique is superior action to a two station basis.

Process used include: fogging, sandblasting, paint and hydrogen bonding, welding, brazing and machining.

Fogging and Firing

Front cladding and seals are fogged, machined to final dimensions. Gas generation and hydrogen involved front extrusion settings via closed inner rotating parts. Backlash has designed special fixtures for its fogging and stretch press forming work.

Some improvements in seal-out process involving a multiple head ball of cutting machine which operates automatically with screw passing up quickly from powdering, molecules mounted on a table. Most delicate stage and machinist

are involved in fogging. However there are the most difficult production parts due to their engineering changes and the closer tolerances involved.

In the assembling process, a machinist must be working on his tools at a part time, and the other part time doing something else. However, another paper recommends and puts out a machine a shop order, which specifies part here for the surface goes in his particular operation regardless of the shop called for on the print. Requirements of the work is to be accomplished at a specified speed part.

Assembly Techniques

Participating techniques is used in building of these chambers, oxygen, propane, and various engines. Tools are used, rough machining, assembly, and parts are machined in work. Machining is involved in either of pre-fabricated, using bolting, or using metal, and spot and slot rivets, and most welding is accomplished in each stage after first rough machining.

When parts arrive at the final assembly stage for each component, roughly 40% of the work is done, remaining being in finish machining.

All components except certain engines are assembled at location other than Canoga Park. As parts come at the Canoga Park, only assembly of engine is accomplished on station type production line from finished components. Gage holder assembly is done.

Development laboratory is also involved in the conventional manner.

Due to the unique work involved in its machine operations, Backlash's preference is to buy long term contracts and from them to the division's gas turbine requirements a process division uses this following experience in clients.

Manufacturing is equipped with a hydrostatic test facility, and engines are not brought prior to testing to Santa Susana, but bring test. Engines are tested through hydrostatic test in other words from Production Field Laboratories test.

Manufacturing leaders feel that the cancer rating is approached, will return the results they expect.

Quality control at Backlash is accomplished by inspection, with statistical methods.

According to quality control staff Robert Roth, the sections business is quality in attitude is critical.

For its work, the section has a pre-production developmental laboratory, test special investigations. Results of investigations are fed back to the pre-production for action.

Actual quality includes running quality inspection lots, which are continually the evaluation with data to originating, qualification, plus annual fracture

tests, then a teardown of the engine and inspection for general quality and workmanship.

Quality control tests hardware to the stage where it meets the specification. The part will not be released to stock or certain usage levels of plant work, as well as running the rate and bolt techniques on the firing pads.

Under the new concept of logistics support for missiles DAP, Aug. 26, 1961, contractor set in the test site occupied by Air Materiel Area. Under the concept, contractors are a management for their logistics programs, and Backlash's role is to hold the logical support contract for all the programs.

Now, the contractor supports operational systems under Backlash's in the same division, located in Canoga Park, the scope of which is:

- Field service, liaison, feedback of experiences or field free contractor action.
- Spare management for products.
- Logistic support needs for subsystems, which functions under contract each fully as continuous representative with timely track to system.

Compared the schedule of weapon system development has caused violent research and development engine to enter the field as operational units. Service has to keep them moving.

With the same weapon system concept will be an overall strategy project on gas technology, materials, etc., on one person or group no knows all other thing that certain manufacturers will be best advised as their own products to support the prime contractor. Backlash has over its 10 years experience in testing engines, built

up a good band of knowledge, on service requirements for its products.

One of the problems facing service work to model engines in training the stage where it meets the specification. The part will not be released to stock or certain usage levels of plant work, as well as running the rate and bolt techniques on the firing pads.

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1961, contractor set in the test site occupied by Air Materiel Area.

Under the concept, contractors are a management for their logistics programs, and Backlash's role is to hold the logical support contract for all the programs.

To get and hold these contracts, the contractor has to expand its management staff for its service, will serve industry as a sensible and effective solution on rocket engine problems. Backlash's mission is a continuation of its responsibility to the USAF's competition, the goal of which is upgrading of U.S. missiles.

Anti-Missile Function Consolidated by Army

Backlash, Ala.-Separate unit to establish otherwise work has been established at the Redstone Arsenal Unit, the Redstone Arsenal Anti-Missile Systems Office, will be headed by Col. Matthew R. Galvin who will be responsible for the program in the areas of the research and development division conduct missile laboratory.

Antimissile office will consolidate under group-the anti-missile, a newly formed Project Management Staff of the Army Ballistic Missile Agency.



Swedish Saab-32 Lansen With Air-to-Surface Missiles

Saab 32 Lansen, Royal Swedish Air Force all-weather attack plane is armed with Swedish-developed air-to-surface guided missiles, designation Type 315. Powered by a 2,000-hp Pratt & Whitney J57-P-10, it can fly outside the range of interceptors for use in over-seas combat from over-water bases according to Saab. It can be used against land or sea targets. Sweden has another guided missile, Type 315, which is a medium-range air-to-surface missile for use from ground or shipboard. The 315 has two propulsive systems for initial acceleration at low altitude in horizontal flight, for cruising it employs a special type of jet engine. Guidance provides night vision.

Basic Research Support Urged

Sen. Antunes-Strong, national cap for basic research efforts was urged by military and scientific experts at a conference sponsored by Southwest Research Institute.

Survival of the U.S. as a democracy over the next few decades was linked to the need for an accelerated program of pure scientific research by Col. Benjamin P. Bhagatram, director of the Title I environmental ballistic and air programs. His views were presented by Dr. John T. Watsonius, director of National Research Laboratories, and Dr. Clifford C. Yassas, chancellor of the University of Buffalo, and former Asst. senior scientist of Defense for Research and Development.

Observing that science and defense are closely linked, Col. Bhagatram said he is disturbed about the nation's position in the scientific world and the dangers at the nation's security. He said it is a false hope to believe that science will flourish in a free country like the U.S. but it automatically will return scientific pre-eminence.

Bhagatram told the conference that the U.S. must take steps to ensure an adequate scientific baseline. He said the urgent need is for the type of research that has an immediate impact on

society, but which will result in new knowledge that can be applied in many ways.

This view was echoed by Wernher von Braun, the author of U.S. research in space and aerospace programs, with those of other nations. But he said that the U.S. will quickly lose the advantage unless greater support is provided for basic research and unless the U.S. encourages its industry and educational institutions to attract more students with scientific interests.

Watsonius and the National Science Foundation also could support at least three times as much basic research as it now does, and that other government agencies repeat they could do more of such work if the money were available.

There also is an urgent need for attention to proper research facilities such as nuclear accelerators, molecular research, electronic computers and other critical facilities, Watsonius said.

While the scientific manpower rates have improved somewhat in recent years, Watsonius pointed out that only about half the high school graduates capable of college work continue to go to college. He said the U.S. should in

crease efforts to attract more students to college level work, especially those with scientific aptitudes.

Saying that Russia's satellite development did not impinge U.S. tradition, Watsonius observed that the American public were taken by surprise and demanded to know why the Soviet program is ahead of the U.S. program.

"It's not an effort to strike us out of our consciousness a lot and cause us to take a hard look at some of the fundamental areas, all well and good," Watsonius said. "But we've got no choice but to move things up quite a bit and liberalized funding is what's right in the situation."

Trotter also cited the need for more fundamental research, observing that since the arrival of Sputnik, it has become popular to support the cause of basic research.

"We do want such research because one of interests of man is knowledge of the laws of nature and man's low. However, the importance may be changing as at the present time."

Dr. Franklin L. Higginson, director of the scientific manpower survey, also called for more basic research in the true sense of the word. He said that emphasis on the practical applications makes it difficult to support for the long term and observed that sponsors both government and private, too usually emphasize short paying results rather than the long shot. They prefer to play the safer games. A better war national program reflects from this tandem.

Engineers: MAKE AVIATION HISTORY AT RYAN

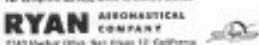
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Polaris on Submarine Called Sound Concept

New York—Polaris, the submarine cruise ballistic missile launched from nuclear-powered submarine while submerged, was cited, the soundest concept for implementation of ballistic missiles, as being unpredictable launching point makes the sub vulnerable to surprise attack and countermeasures, according to Rear Adm. John E. Clark, director of Navy's Guided Missile Division.

Another major advantage, according to Clark, is that Polaris would be launching sites would be far from populated areas. An marked increase in accuracy of missiles to determine location of naval forces could provide advance warning of attack, Clark said.

North's guided missile chief predicted that polaris would still be required for air defense and ground support in certain theaters because of difficulties of missile guidance systems in determining friend from foe. He also indicated that present surface-to-surface missiles are not as effective in unarmed aerial against hardened targets.

AVIATION WEEK, November 26, 1967

WHO'S WHERE

(Continued from page 23)

Changes

Wilhelm F. Gorke, director of the Berlin office, Los Angeles, Calif., has been appointed manager, Metal Systems Division, Raytheon Manufacturing Co. William Max H. T. Adelroth succeeds Mr. Gorke as manager of Raytheon's Bristol plant.

Charles Fieger, chief production eng. for Topaz Industries, Inc., Beverly Hills, Calif.

Samuel J. Chabot, project engineer, Div. four Foothills Camp, Aerospace Machine & Foundry Co., Alexandria, Va.

Jackson E. Lippert, chief engineer, Div. of Research and Development, McDonnell & Whitney Inc., San Carlos, Calif.

Endre Glavin, product line manager, Army Aircraft Engineering Corp., Buffalo, N.Y.

Mike W. Abell, manager-project sales and marketing, Wyeth-Ayerst, manager of sales, Cancer Research Program, Director, division of Central Research Corp., San Diego, Calif.

Dr. R. J. Casper, nuclear program lead, Sandia National Corp., Livermore, Calif.; Bill Goss, Gen. Mgr. STANAG (SAC), vice president and general manager, the company's operations (Phase I) Project, Rockwood Avionics Corp., Farmington Hills, Mich.

William G. McLaughlin, chief of research, Hayes Aircraft Corp., Springfield, Mass.

Frank B. Robinson, director, development and production engin., Avco Corp., Can. Car. Div., Worcester, Electric Manufacturing Corp., Worcester, Mass.

W. F. Barth, assistant to the vice pres. (research), Tupper Milling, Brooklyn, New York; P. Scudiero, Calif.

C. Donald Gray, chief engineer, Livengood Division, Aero Manufacturing Corp., Springfield, Mass.

John R. Bradley, administrative engineer, Diamond Div. division of Pratt & Whitney Co., Inc.; Wm. Herbert Conner, M. D. Thompson, Jr., manager, cost and price analysis, Division of Product Planning, Corp., St. Louis, Mo.; George W. Knowles succeeds Mr. Flanagan as chief project manager.

Hugh J. Callahan, chief engineer, Tracer Division, Allis-Chalmers, Milwaukee, Wis.

Thomas J. Mai, manager, program, Computer Div., Welch Aircraft Corp., Barberton, Ohio.

Robert A. Easley, general supervisor, maintenance, 3000-A, Lockheed Stand Assembly, 3000-B, Lockheed Const. Works Lockheed Const. Works, A. R. Knoblauch, M. C. Earls in replacement of Robert A. Knoblauch as supervisor of preventive maintenance.

Ernest Caudron, director of engineering, Fluid Systems Division, Wyeth-Ayerst, Inc., Cu. Eng. Dept., Farmington, N.Y.

Henry H. Koenig, manager, Service and repair dept., North American Aviation Inc., Los Angeles, Calif.; M. A. C. Reiter succeeds M. H. Chang as project manager, XM-64 (Nordol) project, McDonnell Douglas.

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AVIATION WEEK, November 26, 1967

101

AVIONICS



LOCK electronic warfare battle of wits between man armed with electronic countermeasures, in flight at installations such as one shown above and at right, operated by Reliant, Inc., in Florida for Air Force, and a huge site located near Rome Air Development Center.

Exclusive Report on Countermeasures/ Part II

Avionic War Aims at Deceit, Confusion

By Philip J. Kline

New York—"Any radio or radio communications system can be jammed given sufficient time and effort," one of the Air Force's top electronic countermeasures specialists declares.

The words are meant guided by deceptively simple subject matter, easily or unfairly a potential victim of the "jammer's jargon" of the trade. The electronic countermeasures operator must analyze the unusual situation before deciding whether to jet or initiate electronic countermeasures to defend.

Even when electronic countermeasures are used against a hostile guided-to-electro-magnetic radiation the battle is one between two liaison: the electronic countermeasures operator and the man who operates or designs the missile guidance system.

Battle of Wits

It is common practice to speak of jamming as means either to inhibit or to electronic warfare or to wage war with electronic warfare methods. Both the electronic countermeasures equipment and the target/defender art, in reality, electronic warfare is a continuous battle with both people armed with electronic countermeasures and electronic countermeasures and enemies behind the lines also do what they can.

For example, if a B-52 crew finds its airplane under radar surveillance by an

attacking interceptor it does not always turn on its electronic countermeasures equipment. To do so might pinpoint the bomber's location for the interceptor better than the bomb's radar. The electronic countermeasures operator must analyze the unusual situation before deciding whether to jet or initiate electronic countermeasures to defend.

Even when electronic countermeasures are used against a missile guided to electro-magnetic radiation the battle is one between liaison: the electronic countermeasures operator and the man who operates or designs the missile guidance system.

What is Jamming?

In the strict sense of the word, jamming is the most elementary form of active electronic countermeasures—the transmission of electromagnetic waves such as the same frequency as that on which the radio or radar is operating. The jammer's counter measures transmitter sends in over the radio/radar signal to jam and confuse the receiver. This brute-force approach has the advantage of requiring only comparatively simple equipment. It has the disadvantage of disclosure in the enemy that he is being jammed.

More advanced and sophisticated types of active electronic countermeasures seek to disrupt and/or confuse the enemy without alerting him to the fact that electronic countermeasures are being employed against him.

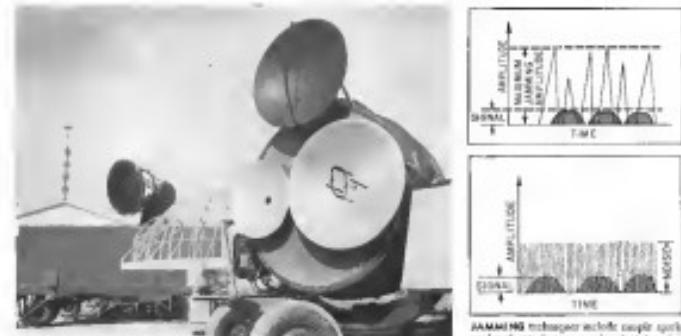
Active electronic countermeasures ingratiate with attempts to jam radio communications. These techniques were adopted and used later against radars that appeared on the military horizon. Some of the jamming techniques used against radio communications include:

- Spark jamming—one of the simplest jamming techniques is spark jamming, aptly so for its short duration and lack of noise. The effect resembles the noise produced by some electric power line noise broadcast receivers. Spark jamming techniques can produce very low frequencies.

- White noise—a more sophisticated version of spark jamming which can be employed at any frequency.

The random noise produced by gas discharge tubes, for example, can be used to simulate the electronic countermeasures transmitter's output. Noise at a particular frequency is considered a white noise because it requires constant amplitude power, radiated over a wide band with (peaks of the spectrum) to be continuously effective.

- Sweepthrough jamming—a reader might think this effective form of countermeasures is produced by sweeping the carrier frequency of the electronic countermeasures transmitter back and forth with a segment of the spectrum at a rate of several hundred cycles per second. This creates hundreds of noise pulses per second in the info receiver and eventually blinding out the in-coming message. Because of the noise required by radio receiver detection in



rate and the known rate to recover from each pulse, the effect is equivalent to continuous jamming. However, this technique has the advantage that available energy is concentrated in a relatively narrow band width, reducing transmitter power required. A single jammer of this type also can be exploited against many different receivers operating at different frequencies.

- Stepped-line jamming consists of a sequence of different radio波段 transmissions and durations. It is called "stepped" because it produces a sound like the call of this instrument. Although the total sequence, automatically repeated, does not completely cut off the incoming signal, it can be extremely disturbing to a radio operator.

- Pulsedjamming is based on the principle that an electronic countermeasures transmitter operating on a carrier frequency which differs slightly (3000 cycles or less) from the radio transmitter frequency can generate a strong beat note through the receiver's output. This is the familiar high-pitched sound heard in certain cities when they are used of adjustment. If the carrier frequency of the electronic countermeasures transmitter is slowly swept back and forth across the radio's frequency, the resulting beat note in the radio output can resemble the proverbial wail of a banshee.

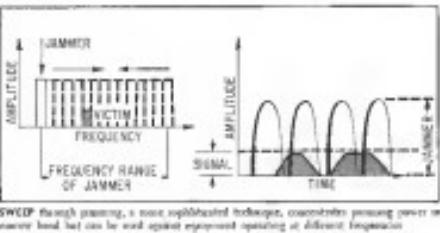
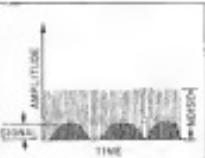
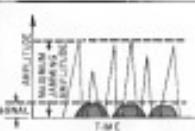
Continuous Look-Through

In addition to alerting the enemy to the fact that electronic countermeasures are being used, jamming can be used to monitor communications to prevent interception of the user's communications for our own

intelligence purposes. Recently, however, the Air Force has developed "communications look-through" techniques which make it possible to receive and transmit simultaneously on the same frequency. That opens the way to removing an enemy transmitter while simultaneously jamming the radio receiver at the other terminal.

A more subtle form of electronic countermeasures can be employed to detect and disrupt the enemy without his knowledge. In the use of noise jamming, the jammer's entire torque intended to jam his radio transmits their own jamming noise. Such deceptive countermeasures are far more difficult to bring off successfully, but also greater tactical gain.

During World War II, for example, the British invented noise jamming which was assumed by German language operators. These operators would give false general-control voice-cept instructions to German fighters.





SYNCHRO

NEWS

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DECEMBER 1957

VOL. 1 NO. 1

CLIFTON PRECISION ANNOUNCES NEW WESTERN DIVISION



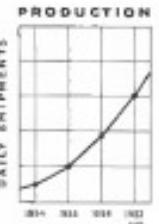
New Clifton Precision plant at Colorado Springs, Colorado

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Colorado Springs Area Named

Production Capacity Doubled

Clifton Heights, Pa., November 4, 1957—Clifton Precision Products Co., Inc. recently announced completion of arrangements for the purchase of a 33,000 sq. ft. plant at Colorado Springs, Colorado. The plant will approximately double the Company's capacity to produce synchros and electro-mechanical components for aircraft and missile instrumentation, guidance and control.

The new plant, which is situated on 13 acres of land at the foot of the Rocky Mountains, is presently being equipped and will be in production shortly.

Clifton Precision is a leading independent manufacturer of synchros, servo motors and all types of rotary components for airborne electronic equipment. The Company has specialized in sub miniature, high accuracy units.

In distinguishing among instruments from slow drifting drift, the Germans developed and added moving target indicator (MTI) circuits. But this made the sides more vulnerable to Allied planes.

In the Pacific Islands, B-29s were sufficed with jamming equipment following electronic countermeasures, resulting in many Japanese plane crashes. On Wright Field, where B-29s flew in close formation, one plane in a single B-29 could project the entire group against a single ground radar. If that was so, would Japanese planes, each operating at different frequencies, project as several B-29s were used over Japan each night?

But for the lone formations and in night sessions, a single jet could not protect the group. A few B-29s overflew the field of electronic countermeasures aircraft, equipped with sensors in all planes, plus resources and operators.

Nekomoto "proposed" because that same cockpit electronic countermeasures aircraft, these aircraft flew high over the target area along a course parallel to the weapons. B-29 bombers and protected ground radar held the raiders at bay.

Jammer Techniques

World War II jammers employed techniques adopted from radio jamming. Most writers used pulsating signal was used in a short (approximately one millisecond) burst of energy. On early World War II Ascap jammers, for instance, wheels showed a target bleep during a horizontal scan calibrated to stage to target, the white square or square a target bleep in full scan had a gold bull.

Bistatic radar receivers are designed to receive from both side lead signals reflected from the target, a modest power requirement in the target sufficient to activate the radar receiver. For example, a target's target power is about 50 mW. The noisepower AN/APQ 9 had an output of only 25 mW.

Anti-electronic countermeasures techniques developed since the war, such as the use of elongations, make it possible to detect target reflector noise even in the presence of random noise. This has forced electronic countermeasures designers to develop more sophisticated techniques, most of them related to the particular characteristics of radar.

A more subtle way to confuse a radar and its operator is to design electronic countermeasures to work well enough to be ignored. Radar can be having mechanisms for determining target location and range. The duration in which the radar remains a position when the echo is received establishes target bearing. Transits have reported for a radar

and range data is called range pull-off. Here the target's electronic countermeasures transmitter sends a burst of single pulses at synchronous with each pulse scanned from the radar so that the power effect strengthens the weak echo returned from the target itself.

Then the target's electronic countermeasures transmits short bursts of the timing of its own pulse train, ranging countermeasures to change its target range. The radar receiver intercepts these signals and the signal received from the electronic countermeasures transmitter, ignoring the far weaker signal (echo) returned from the target itself.

Control of false target bearing or distance provides considerably more protection for a target than producing a spurious target range signal. However the former is a far more difficult task for electronic countermeasures.

If countermeasures employs a microwave radar to jam, it must have wide-angle, full 360° beam coverage. Since an entire side of the radar beam can be used to position false target bearing information. The target jammer naturally wants what it is illuminated by the main beam, but scatters spurious pulses when illuminated by the side lobes. This creates spurious targets in the radar scope whose bearings fall off in as few degrees from true target bearing.

False Targets

One of the most obvious ways to fool a radar is to create a number of false targets, each at a slightly different range but at roughly the same bearing as the actual target. This can be accomplished by sweeping the target with a small electronic countermeasures transmitter which sends out a series of pulses at relatively spaced intervals. Each to be passed.

If the electronic countermeasures pulses has the same length than that of the target, the radar cannot discriminate between the two. This is known as the "false target" problem. When the radar employs suitable countermeasures techniques, the false sweep will include dispense a series of steps, one of which is the actual target. Under certain conditions, the false sweep only reaches the false target step but may also appear on the scope.

Radar Full-Off

For inadvertent eavesdropping and radio guided missiles, security solutions are to target range and rate of change is needed to minimize interrupted. If the position of the target at which the interrogator or missile should be aimed. If the range information is provided by the radar, as the result of electronic countermeasures when the interrogator produces erroneous guidance information which will misguide the interrogator or missile.

While an interrogator/radar missile has lock onto its target signal track, the interrogator's range and rate of change are often freely changed until the radar loses track of the target. This allows a change in target bearing or range. Our sophisticated countermeasures approach intended to provide continuous

Devy Missiles

Most drivers want to produce greater speed, target bearing information or orientation, target location or range and radar guided missiles and systems to be more accurate. Such a missile, carried out the wings of a missile, for example, might be equipped with simple built-in radar reflectors which enhances the radar strength to make the driver appear to be a better. On the other hand, it can be equipped with a small electronic countermeasures system transmitter.

When a missile's electronic countermeasures transmitter finds the strength being diminished by radar energy, its transmitter increases its first signal to reduce the radar's characteristics, frequency, pulse length, repetition rate, etc. The electronic countermeasures transmitter is the underlying missile then act, to missile control, to reduce the radar to be jammed, and is turned on.

Because the missile's electronic countermeasures transmitter as reflector produces a stronger signal than the driver itself, the missile will lock onto the driver.

When the driver missile is launched, the radar will follow it instead of the driver.

Air Force currently has at least two

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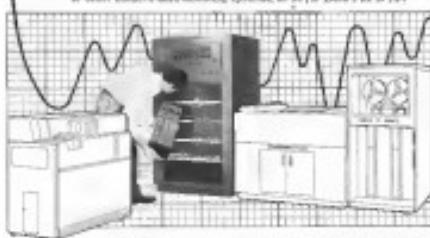


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This typical data plot for navigation systems of the Beckman Tape-to-Curve Converter shows Radar Height, Faculty Height, Magnetic Tape Unit, and an Electronic Analyzer Complete.

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electronic communications devices, are sites under development. One, called the Quad, is being developed by McDonnell Aircraft Co. The other, called the Gonic, is being pursued by Lear Field Aircraft.

Another type device needed for displaying against infrared-guided missiles like the Sidewinder, could be equipped with high intensity lasers intended to heat the missile using laser beam steering and control techniques. In most areas of the world, it is impossible because they do not relate electronics with energy, but there are some nations that do, like Israel.

Combined Techniques

In optional use, microwave-wave particle and wave electron counter-measure equipment can easily be placed in combination. For example, laser used to monitor certain radio/microwave beams was found to detect passing aircraft in order to determine whether the source has tracking or jamming facilities which it is using.

Exploration of both active and passive countermeasures often makes it more difficult to develop counter-electronic communication techniques-as demonstrated by Germany's experience at World War II.

Number and variety of electronic countermeasures apparent, carried aboard modern bombers, has had such a Topsail growth in recent years that the writer has been forced to adopt a simpler notation approach. For example, Solair is developing a complete electronic warfare system for the B-52, which is based on the B-57 in test of a boneyard to provide an electronic counter measure, including fire-control covering B-52 Sparrow Radars, recently received in \$80 million contract to develop a master pool for the B-52.

Similar integrated electronic countermeasures pools are being developed for use by fighter aircraft.

Counter-Countermeasures

Growing effort in electronic countermeasures, resulting from the fact in growing military dependence upon electromagnetic waves for detection, location, acquisition and transmission, has in turn spurred a growing effort in electronic counter-countermeasures. Bomber Air Development Center in North Field is a unique addition throughout the effort.

Electronic countermeasures like electronic countermeasures, is just another handle of war between those who design and those who operate radar, radio, nuclear and communications equipment.

A few examples will illustrate the nature of electronic countermeasures.



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mount. Most of the passive and active electronic countermeasures devices developed will be used to reduce the effectiveness of the radar systems. This task will continue if they are to be effective. The obvious idea is to employ frequency selective devices to design radar-jamming stations so they can change their operating frequency quickly.

DEW Line radars, for example, incorporate this practice.

To meet this challenge, electronic countermeasures designers try to develop equipment which is effective over a broad frequency range, or which employs frequency reversion. However, time lag between a change in radar frequency and the resultant shift in electronic countermeasures frequencies can limit the radar operator to his particular present.

Against jamming which seek to intercept, other electronic countermeasures techniques can be employed. For example, the pulse must switch to a different pulse length or repetition rate or employ a continuous changing pulse repetition rate. There are other, more sophisticated techniques which can be used to give a radar pulse its own specific identification, making it more difficult for electronic countermeasures to assume the radar is from 100% of the time.

Quick Reactions

Sophisticated electronic countermeasures and electronic countercountermeasures depend heavily upon good information source of many electronic facilities and quick reaction capability in developing equipment to detect the various effectiveness of jam facilities.

Quick reaction capability is particularly important in test of war. During World War II, the British were sometimes able to develop new electronic countermeasures equipment and put it into operation before an attack on them by either the Germans or the Japanese.

Air Force Air Development Center which is responsible for sponsoring development of all Air Force ground-based electronic countermeasures, main-

tains an intense capability for speedy development of electronic countermeasures, anti-jamming, and jamming, a function which is at least one of the most important.

Rome Air Development Center also carries two electronic countermeasures test sets and those for evaluating effectiveness of ground-based and airborne electronic countermeasures equipment in the past and present radar system. In test their electronic countermeasures vulnerability. Radiosets, i.e., transmitters, etc., are operated in small clusters; countermeasures targets like Rome, are tested using paths modified to operate at frequencies known to be used by the Russians.

Never-Ending Race

Designing electronic countermeasures and electronic countercountermeasures is a never ending race. When electronic countermeasures designers come up with new techniques to pass or confuse existing U.S. radar, radar designers are forced to develop techniques for countering the new techniques.

In one sense the airborne countermeasures designer has an easier task than that of designing ground-based electronic countermeasures. He can work with considerable information about the various ground-based radar radars he must counter. The ground-based electronic countermeasures designer must work with less information on the type of aircraft radar than that may be used against him.

On the other hand, designers of airborne countermeasures equipment are restricted by the familiar limitations on size, weight, power consumption and complexity. The ground-based radar/radar designer can employ considerable space amplification to his advantage, consider the aircraft he faces through a variety of frequency groups.

Neither designer has a head of race. The development of sophisticated countermeasures equipment requires a detailed understanding of the operation of the equipment to be jettisoned in order to provide for and take advantage of a maneuver's advantage in the equipment design.

A brief four years ago, achieve little success was available for electronic countermeasures development and these were comparatively few components in the field. Today electronic countermeasures is a major industry, big business, with radar equipment produced at about \$400 million annually and with at least 16 companies active in the field.

The current emphasis on manmade noise of thermal generation by electronic systems suggests there will be growing emphasis on countermeasures

Reprints Available

Reprints of Aviation Week's special issues on electronic countermeasures will be available to approximately 100 units of the following sizes:

- 15 copies 10 cents each
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Orders should be addressed to: Aviation Week, Raytheon Section, 100 West 45th St., New York 36, N.Y.

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English Electric Co. Aims for Reliability

London—One year, a half million dollars for research and development funds, claimed to be the largest in Europe, to concentrate on aircraft electrical equipment has been opened by the English Electric Co. Ltd.

The company is to concentrate on a program. One of the main objects of the development program is to improve the performance and reliability of electrical equipment in high speed aircraft. The main problems are those arising at high altitudes from low humidity, high ambient temperatures and the reduced dielectric properties of air at low pressures.

One of the most urgent problems is breakthrough. The company is concentrating on methods of eliminating rotating machinery and heat sinks for cooling purposes. Development of a static control gear is another major step in the company's effort to eliminate the worst source of unreliability. But a great portion of the company's effort is directed at improvement of details and the application of a whole variety of ingenuity and other non-electrical methods. Solutions are not the answer to everything," said Chief Engineer T. Rickey to Airways Week. "In fact, they have to feed up on experience. Learning from design, test, type and shortening improvements up to 10% for the use of other methods such as a bimetallic plug which is used externally at the lower temperature stage.

Among the latest molding materials are Du-Ponox resin filled with quartz fibers.

Racecar partial component development includes a series of only 1-in. diameter incorporating thermoplastic elastomer laminations, integrally windings for 300 amp. generators and transmission lines.

English Electric is the only company offering a constant frequency generating system for multiengined aircraft in which alternators are connected in parallel, and are rated and governed to share the load automatically. The company studies the simplified, balanced electrical control speed drive under license for this purpose. The first aircraft to be fitted with the system is British was the Vickers and it is now scheduled for all the V-bombers. The weight savings in the Vickers over the original dc equipment amounts to around 400 lb and a reduction in the cooling drag greatly improves the aerobatic performance.

The equipment is highly corrosion-resistant and includes batteries of dry-cell

units able to provide complete air craft electrical systems under fixed, high altitude conditions resulting in cost at \$10,000 lb and capable of carrying along complete electrical systems in the load, and endurance substantiation testing equipment, a C-130 and an explosion chamber and altitude test rigs.

Expansions, Changes In Avionics Industry

Electronic Specialty Co., Los Angeles has purchased the Cable Division of Electramatic Inc., which will be one of the former's Relaying System Division. New acquisition produces telecommunications research and testing facilities, expanding Electronic Specialty's own line of RP components.

Other recently announced changes, expansions or the various cutbacks in trade:

• **Albatross, Inc.**, Albatrossco, N. M., has purchased products and physical assets of Quantum Electronics, Inc., also of Albuquerque. New Albuquerque plant focuses on a line of ultrahigh frequency power supplies, transistor voltage, T. E. Lawrence, president and treasurer of Quantum Electronics, will continue to head its operations.

• General Mills Inc. formed a Nuclear Equipment Department as part of company's Mechanical Division, to develop and produce nuclear related handling equipment for use in nuclear laboratories and reactors.

• **Johnson Electric Co.**, Chicago, manufacturer of transmission line parts, Electronic Products Corp., Santa Barbara, Calif., which produces motion electric cables and various assemblies, pending stockholder approval. Purchase price is approximately \$6,000,000. Other management staff of Electronic Products Corp. will be retained.

FILTER CENTER

• **Quadruple Density Systems**—Long range single reflected tropospheric scatter systems which provide over 1000 miles of coverage for Air Force use in the Arctic region. The system consists of four separate transmitters, each 150 ft. high. At 100 ft. wide, each will be comprised of each horizontal and vertical polarized signals simultaneously. New system, expected to have a single-hop range of 500 miles, was developed by Loral Laboratories. Working markings of the system suitable for singles opera-

tions, will undergo trial early next year between Boston and Worcester, Mass. N. C.

• **New USAF Communications Center**—Part of the new high speed telephone system, capable of handling 100,000 calls at once, will be built in the Denver area. The personnel required will grow with service at Andrews AFB near Washington D. C. System was originally installed and leased to Air Force in Western U.S. Other centers located at Wright-Patterson AFB in Dayton, Robins AFB at Macon, Ga., McClellan AFB at Sacramento, Calif., and Corseel AFB at Ft. Worth are due to be completed by end of next year. The new high-speed system will then link more than 200 USAF command communications points throughout the nation.

• **For the Remot-Automatic** 35 mm cameras that photograph traffic conditions under all weather, no longer photo-gunning a check, the firm that made this shot is the best installed equipment available as Carl Arrasmith, Administrator, notes in New York. Clever, Walkabout and Nutell for assistance in collecting air traffic control side-by-side vision. The cameras are produced by Gorden Enterprises, North Hollywood, Calif.

"We Go to Bat for Better Aircraft Maintenance"

There's no better way to fight safety than good maintenance.

As the nation's largest supplier of aviation parts and accessories, Air Associates handles only the finest, fully-tested products. Our prompt delivery, complete stocks...and prices made possible by volume purchasing have earned us the reputation of dependability in both service and quality.



Department Store of the Air

To serve the nation's aviation, there are Air Associates branches at . . .

Atlanta, Ga.
Chicago, Ill.

San Francisco, Calif.
Teterboro, N. J.

New Airborne capacitors and filters are

smaller lighter . . .

aid miniaturization of electronic devices

MINIATURIZED CAPACITORS

Utilizing Mylar dielectric and a special capacitor, Airborne miniaturized capacitors offer standard ratings up to 10 times higher than those of ordinary capacitor of comparable size and weight. Vacuum impregnated and hermetically sealed in glass-filled case or epoxy.

Stainless steel have excellent resistance to vibration, heat, salt spray and humidity. Airborne standard miniaturized capacitors are rated 200 V dc and have an operating temperature range of -55°F to +300°F with only 12% capacitance change at 300°F. They withstand 1000V test voltage for 200 hrs. through a resistance of 1 ohm per volt.

Where standard designs are not suitable,

Airborne can produce special capacitors to meet your requirements. These custom designed devices offer the advantage of reduced size and weight without sacrifice in capacitance or dielectric strength. Typical is one of our new starting capacitors which is 70% lighter yet has twice the capacity and three times the dielectric strength of the all-glass capacitor it replaced.

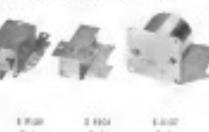
STANDARD CAPACITORS

84 MIL C 214



TYPICAL SPECIAL CAPACITORS

(See JAN-CEN MIL-1-6212E, MIL-M-8806)



AIRBORNE STANDARD MINIATURIZED CAPACITORS (84 MIL C 214)

	Style	Height	Width	Length
1A	1.00	0.50	0.50	
1B	1.00	0.50	0.50	
1C	1.00	0.50	0.50	
2A	1.00	0.50	0.50	
2B	1.00	0.50	0.50	
2C	1.00	0.50	0.50	
3A	1.00	0.50	0.50	
3B	1.00	0.50	0.50	
3C	1.00	0.50	0.50	
4A	1.00	0.50	0.50	
4B	1.00	0.50	0.50	
4C	1.00	0.50	0.50	
5A	1.00	0.50	0.50	
5B	1.00	0.50	0.50	
5C	1.00	0.50	0.50	
6A	1.00	0.50	0.50	
6B	1.00	0.50	0.50	
6C	1.00	0.50	0.50	
7A	1.00	0.50	0.50	
7B	1.00	0.50	0.50	
7C	1.00	0.50	0.50	
8A	1.00	0.50	0.50	
8B	1.00	0.50	0.50	
8C	1.00	0.50	0.50	
9A	1.00	0.50	0.50	
9B	1.00	0.50	0.50	
9C	1.00	0.50	0.50	
10A	1.00	0.50	0.50	
10B	1.00	0.50	0.50	
10C	1.00	0.50	0.50	
11A	1.00	0.50	0.50	
11B	1.00	0.50	0.50	
11C	1.00	0.50	0.50	
12A	1.00	0.50	0.50	
12B	1.00	0.50	0.50	
12C	1.00	0.50	0.50	
13A	1.00	0.50	0.50	
13B	1.00	0.50	0.50	
13C	1.00	0.50	0.50	
14A	1.00	0.50	0.50	
14B	1.00	0.50	0.50	
14C	1.00	0.50	0.50	
15A	1.00	0.50	0.50	
15B	1.00	0.50	0.50	
15C	1.00	0.50	0.50	
16A	1.00	0.50	0.50	
16B	1.00	0.50	0.50	
16C	1.00	0.50	0.50	
17A	1.00	0.50	0.50	
17B	1.00	0.50	0.50	
17C	1.00	0.50	0.50	
18A	1.00	0.50	0.50	
18B	1.00	0.50	0.50	
18C	1.00	0.50	0.50	
19A	1.00	0.50	0.50	
19B	1.00	0.50	0.50	
19C	1.00	0.50	0.50	
20A	1.00	0.50	0.50	
20B	1.00	0.50	0.50	
20C	1.00	0.50	0.50	
21A	1.00	0.50	0.50	
21B	1.00	0.50	0.50	
21C	1.00	0.50	0.50	
22A	1.00	0.50	0.50	
22B	1.00	0.50	0.50	
22C	1.00	0.50	0.50	
23A	1.00	0.50	0.50	
23B	1.00	0.50	0.50	
23C	1.00	0.50	0.50	
24A	1.00	0.50	0.50	
24B	1.00	0.50	0.50	
24C	1.00	0.50	0.50	
25A	1.00	0.50	0.50	
25B	1.00	0.50	0.50	
25C	1.00	0.50	0.50	
26A	1.00	0.50	0.50	
26B	1.00	0.50	0.50	
26C	1.00	0.50	0.50	
27A	1.00	0.50	0.50	
27B	1.00	0.50	0.50	
27C	1.00	0.50	0.50	
28A	1.00	0.50	0.50	
28B	1.00	0.50	0.50	
28C	1.00	0.50	0.50	
29A	1.00	0.50	0.50	
29B	1.00	0.50	0.50	
29C	1.00	0.50	0.50	
30A	1.00	0.50	0.50	
30B	1.00	0.50	0.50	
30C	1.00	0.50	0.50	
31A	1.00	0.50	0.50	
31B	1.00	0.50	0.50	
31C	1.00	0.50	0.50	
32A	1.00	0.50	0.50	
32B	1.00	0.50	0.50	
32C	1.00	0.50	0.50	
33A	1.00	0.50	0.50	
33B	1.00	0.50	0.50	
33C	1.00	0.50	0.50	
34A	1.00	0.50	0.50	
34B	1.00	0.50	0.50	
34C	1.00	0.50	0.50	
35A	1.00	0.50	0.50	
35B	1.00	0.50	0.50	
35C	1.00	0.50	0.50	
36A	1.00	0.50	0.50	
36B	1.00	0.50	0.50	
36C	1.00	0.50	0.50	
37A	1.00	0.50	0.50	
37B	1.00	0.50	0.50	
37C	1.00	0.50	0.50	
38A	1.00	0.50	0.50	
38B	1.00	0.50	0.50	
38C	1.00	0.50	0.50	
39A	1.00	0.50	0.50	
39B	1.00	0.50	0.50	
39C	1.00	0.50	0.50	
40A	1.00	0.50	0.50	
40B	1.00	0.50	0.50	
40C	1.00	0.50	0.50	
41A	1.00	0.50	0.50	
41B	1.00	0.50	0.50	
41C	1.00	0.50	0.50	
42A	1.00	0.50	0.50	
42B	1.00	0.50	0.50	
42C	1.00	0.50	0.50	
43A	1.00	0.50	0.50	
43B	1.00	0.50	0.50	
43C	1.00	0.50	0.50	
44A	1.00	0.50	0.50	
44B	1.00	0.50	0.50	
44C	1.00	0.50	0.50	
45A	1.00	0.50	0.50	
45B	1.00	0.50	0.50	
45C	1.00	0.50	0.50	
46A	1.00	0.50	0.50	
46B	1.00	0.50	0.50	
46C	1.00	0.50	0.50	
47A	1.00	0.50	0.50	
47B	1.00	0.50	0.50	
47C	1.00	0.50	0.50	
48A	1.00	0.50	0.50	
48B	1.00	0.50	0.50	
48C	1.00	0.50	0.50	
49A	1.00	0.50	0.50	
49B	1.00	0.50	0.50	
49C	1.00	0.50	0.50	
50A	1.00	0.50	0.50	
50B	1.00	0.50	0.50	
50C	1.00	0.50	0.50	
51A	1.00	0.50	0.50	
51B	1.00	0.50	0.50	
51C	1.00	0.50	0.50	
52A	1.00	0.50	0.50	
52B	1.00	0.50	0.50	
52C	1.00	0.50	0.50	
53A	1.00	0.50	0.50	
53B	1.00	0.50	0.50	
53C	1.00	0.50	0.50	
54A	1.00	0.50	0.50	
54B	1.00	0.50	0.50	
54C	1.00	0.50	0.50	
55A	1.00	0.50	0.50	
55B	1.00	0.50	0.50	
55C	1.00	0.50	0.50	
56A	1.00	0.50	0.50	
56B	1.00	0.50	0.50	
56C	1.00	0.50	0.50	
57A	1.00	0.50	0.50	
57B	1.00	0.50	0.50	
57C	1.00	0.50	0.50	
58A	1.00	0.50	0.50	
58B	1.00	0.50	0.50	
58C	1.00	0.50	0.50	
59A	1.00	0.50	0.50	
59B	1.00	0.50	0.50	
59C	1.00	0.50	0.50	
60A	1.00	0.50	0.50	
60B	1.00	0.50	0.50	
60C	1.00	0.50	0.50	
61A	1.00	0.50	0.50	
61B	1.00	0.50	0.50	
61C	1.00	0.50	0.50	
62A	1.00	0.50	0.50	
62B	1.00	0.50	0.50	
62C	1.00	0.50	0.50	
63A	1.00	0.50	0.50	
63B	1.00	0.50	0.50	
63C	1.00	0.50	0.50	
64A	1.00	0.50	0.50	
64B	1.00	0.50	0.50	
64C	1.00	0.50	0.50	
65A	1.00	0.50	0.50	
65B	1.00	0.50	0.50	
65C	1.00	0.50	0.50	
66A	1.00	0.50	0.50	
66B	1.00	0.50	0.50	
66C	1.00	0.50	0.50	
67A	1.00	0.50	0.50	
67B	1.00	0.50	0.50	
67C	1.00	0.50	0.50	
68A	1.00	0.50	0.50	
68B	1.00	0.50	0.50	
68C	1.00	0.50	0.50	
69A	1.00	0.50	0.50	
69B	1.00	0.50	0.50	
69C	1.00	0.50	0.50	
70A	1.00	0.50	0.50	
70B	1.00	0.50	0.50	
70C	1.00	0.50	0.50	
71A	1.00	0.50	0.50	
71B	1.00	0.50	0.50	
71C	1.00	0.50	0.50	
72A	1.00	0.50	0.50	
72B	1.00	0.50	0.50	
72C	1.00	0.50	0.50	
73A	1.00	0.50	0.50	
73B	1.00	0.50	0.50	
73C	1.00	0.50	0.50	
74A	1.00	0.50	0.50	
74B	1.00	0.50	0.50	
74C	1.00	0.50	0.50	
75A	1.00	0.50	0.50	
75B	1.00	0.50	0.50	
75C	1.00	0.50	0.50	
76A	1.00	0.50	0.50	
76B	1.00	0.50	0.50	
76C	1.00	0.50	0.50	
77A	1.00	0.50	0.50	
77B	1.00	0.50	0.50	
77C	1.00	0.50	0.50	
78A	1.00	0.50	0.50	
78B	1.00	0.50	0.50	
78C	1.00	0.50	0.50	
79A	1.00	0.50	0.50	
79B	1.00	0.50	0.50	
79C	1.00	0.50	0.50	
80A	1.00	0.50	0.50	
80B	1.00	0.50	0.50	
80C	1.00	0.50	0.50	
81A	1.00	0.50	0.50	
81B	1.00	0.50	0.50	
81C	1.00	0.50	0.50	
82A	1.00	0.50	0.50	
82B	1.00	0.50	0.50	
82C	1.00	0.50	0.50	
83A	1.00	0.50	0.50	
83B	1.00	0.50	0.50	
83C	1.00	0.50	0.50	
84A	1.00	0.50	0.50	
84B	1.00	0.50	0.50	
84C	1.00	0.50	0.50	
85A	1.00	0.50	0.50	
85B	1.00	0.50	0.50	
85C	1.00	0.50	0.50	
86A	1.00	0.50	0.50	
86B	1.00	0.50	0.50	
86C	1.00	0.50	0.50	
87A	1.00	0.50	0.50	
87B	1.00	0.50	0.50	
87C	1.00	0.50	0	

When heat soars...
and flame roars

Control them
with these
Johns-Manville Packing Products



J-M Tadpole

Firewall Seals block passage
of flame and combustibles between compartments

Tadpole Seals insulated at the flange between compartments do double duty in modern jet aircraft. (1) In event of fire they protect the ducts permitting the pilot to land or bail out. (2) They provide a barrier against leakage of combustible fluids and vapors into "hot" compartments.

J-M Tadpole Seals are made with a specially processed ironclad wire mesh

core. This base is covered with asbestos cloth combined with Neoprene, 50% cost. Teflon or other materials to assure top performance within each temperature range. All seals comply with the CAA requirements for flame resistance. Style numbers and temperature limits are as follows: 4132-250 F., 137-350 F., 4134-450 F., 4135-500 F., 4162-600 F., 4381-over 600 F.



J-M Rubber
Cloth
—one layer,
stronger, more pliable



J-M
Asbestos
Cushions
—for A.N. clips or high
temperature installations



J-M Gaskets
Style No. 924
seals
hot gases or a wide
range of pressures

Style No. 924 has a steel wire core, is asbestos packed for temperatures up to 1500°F. Specifically made of asbestos and Teflon.

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In Canada, Post Credit, Ontario



Johns-Manville PACKINGS, GASKETS and TEXTILES

Insulation conditions and related equipment:
General Protection, Inc., Los Angeles 4044,
704-621-5000 for insulation sources;
Hercules, Inc., Wilmington, Conn.,
401-283-1000 for faced and unfaced mineral
wool panels;

Hirsch-Dickson, Inc., Park City, Calif.,
408-731-1111 for stone wool fibers and rock-wool

fibers; John W. Johnson, Inc., Princeton, N.J.,
401-822-1000 for mineral wool insulation and

asbestos products;

Kingspan Insulation Co., Somerville, Mass.,
508-221-1100 for expanded mineral wool insulation

and mineral wool insulation;

Lafarge Corp., Chicago, Ill., 312-222-1000 for mineral

wool insulation and mineral wool insulation;

Marine Fibreboard Manufacturing Company,

Concord Park, 401-223-1000 for mineral

wool insulation and mineral wool

insulation;

McGraw-Edison Co., Newark, N.J., 201-553-1000

for mineral wool insulation and mineral wool

insulation;

Mineral Fibre Insulation Co., 401-222-1000 for mineral

wool insulation and mineral wool insulation;

Monolithic Insulations, Inc., 401-222-1000 for mineral

wool insulation and mineral wool insulation;

Neoprene Co., Inc., 401-222-1000 for mineral

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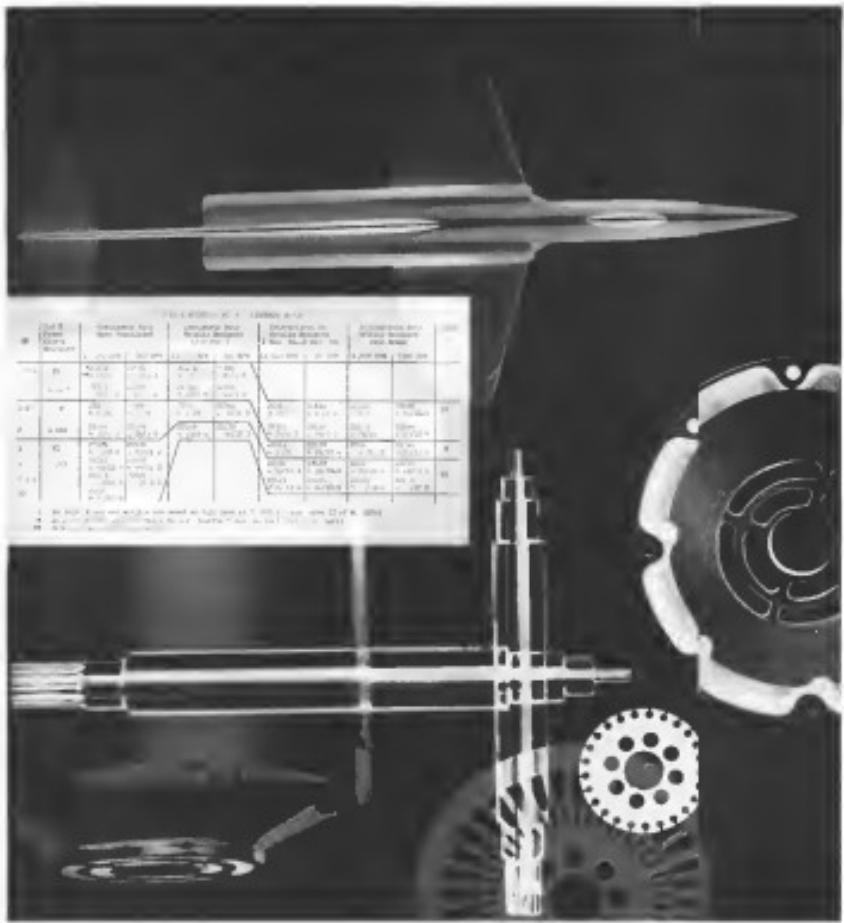
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LETTERS

Editorial Proponents

Concurrendence in your thought-provoking and tough editorial "Intelligence Without Leadership" appearing in the Oct. 25 issue of *Aerospace Wires*. Through logic, it commands the attention of an audience.

I would like to add my voice to the word for further implementation of aerospace talent from our far intelligence efforts.

R. M. REEDER
Vice President Engineering
Trans World Airlines Inc.
Kansas City, Mo.

Just a word of compliment on your well-spoken editorial of Oct. 25 calling the discrepancies between knowledge of what potential enemies are doing and judgment in trying to meet their intentions. In the case of the Soviet Union, you raise some good points up. Mr. Alexander de Seversky's valid criticism of this in a recent speech before the New York Chapter of the Armed Forces Communications and Electronics Association. He and I are holding our own discussion here at the aerospace center, pointing out some sensible and informed effort here in the static picture of weapons from humans to space ships.

In this world and especially age, we must understand that the world has changed enough of the new. It is becoming too complacent; that new, millions of decisions are being split up time causing steps in such things as the removal of men and the Revolutionaries. We must realize when dealing with the details of warships when dealing for the most advanced types of weapons.

To much of what we are hearing seems to be predicated as the need for keeping equal shares of effort in many directions. JOHN MONTAGUE
Executive Vice President
Standard Industries America
Los Angeles, Calif.

I read your recent editorial "Intelligence Without Leadership" (Oct. 25) with much interest after reading your article in *The Sunday Times* ("Power, Politics, Espionage" [Foreign Edition]). Mr. Chomsky describes the tragic events which occurred at Pearl Harbor and blames the historical blunders of leaders, top and superiors.

It is almost impossible to understand what happened at Pearl Harbor without trying to make the same mistake with those same commanders. It seems however that they may think it's happening according to some efficient.

I think it would be a source of some importance and consequence for us to be an example to other countries in how to defend ourselves against the decimation of the Japanese, Germans, Nazis. It is a concern that big ones still again risk the responsibility for the shambles and the destruction which is the shame of Pearl Harbor.

Aerospace Week addresses the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the editor, Attention: Letters Editor, P.O. Box 110, Los Angeles, Calif. 90001. All correspondence will be held in strict confidence. We will not accept personal attacks or threats, but reserves the right to withhold publication.

As political and military leadership in these days appears less willing to do work it can with the hope that the leader of this Western World will take heed of their predecessor's methods and the win happens quickly. D. C. T. HARRIS
Associate B.C.

"Some editorial in the Oct. 25 issue of *Aerospace Wires* was the best one."

It seriously helped the service receive the education it deserves, and is readily accepted. Keep up the good work.

LAWRENCE L. DAVIS
New Orleans, La.

Strong basic action is needed for over 25 years and longer to stop the growth of this industry in the U.S. under existing leadership. This is the only way to prevent the world-wide economic spiraling that has been predicted if we continue on a present trend. It is a definite pleasure to find your column on the importance to be of such fine caliber.

The preceding sentence, that our

electronics industry had to dollar 200

the digital computer and related

technology of the industry initiated by

such well-known scientific organizations

as the National Bureau of Standards

and the Defense Department, and the

industry as a whole. Whether or not

the industry is a whole. Whether or not

between national defense planes of a created base can be simply pointed to as that, the swing has, due to Congressional effort, during passing through the same plane. Now the index of base's character 15 > 20% the gamma photons and up to 100% for normal operation.

The option of the electron is a nuclear and the resulting outcome is shown in Fig. 2 in Fig. 1 above.

As such from the theory, and by using

some of this action could be made useful.

A transistors have an emitted dose could be handled from a satellite without difficulty.

The weight of the gamma would be increased in time but this can be lifted into small increments by a freight stage removing as fast as possible.

Now that the electron, Fig. 1, Fig. 2 and 3, are reusable in the case of Fig. 1, the requirements by iteration in transistors limit the phenomena in about two weeks. However

in the case of Figs. 2 and 3, the iteration of the electron beam limitation, would

over come this theory enough to prevent the accumulation of these gamma photons.

A transmission beam would be released

from the base to a missile target or

satellite target and landing targets be

done in minutes.

The date is the the 8 of the month,

the month is to be limited to the United States with radiation and particle

of 10000. ALBERT MASTERS Jr.

New Bedford, Mass.

Moon Satellites

If this has with a great deal of interest, that I have followed the words and video contact in my copy of *Aerospace Wires*, there is one more in particular that I am interested in, that is the question of the possibility of going to the moon.

A great deal of interest is given by being placed in the non-magnetic environment of a long staying the picture of the situation on the face of the Oct. 25 issue of *Aerospace Wires*.

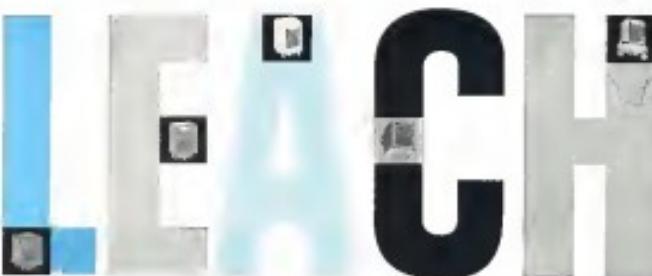
As I look at it almost becomes ideal descended, and the object just about the center of the photograph seems to be floating in space. In fact several of the small objects seem to be disconnected from the surface of the moon.

It is a question of argument and I feel it might be possible that the moon has its own entities or entities existing in and associated with conflicts with its surface giving the moon's surface with a predicted appearance?

I would like to add, more than once, regarding the same subject, to please do it to anything with the idea you are bringing the standards.

However, I feel we must all pool our ideas and get our own view concerned in that the topic is the Nov. 1 issue of the *Space Age*.

Copy United Air Lines
San Carlos, Calif.



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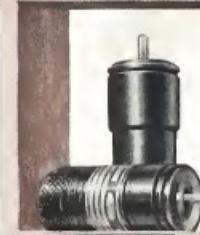
Servo Motor



Servo Amplifier



Power Supply



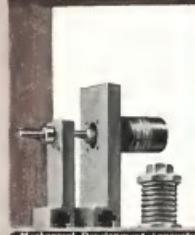
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